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Use of Nuclear Plants in Interplanetary Spacecraft Called Feasible

18610144b Moscow IZVESTIYA in Russian No 190, 16 Oct 88 p 4

[Text] Extract: As has been reported in the press, the critical final stage of the flight of the satellite "Kosmos-1900," which was equipped with a nuclear power plant, was carried out successfully on October 1 of this year.[1]

TASS commentator N. Zheleznov asked Doctor of Technical Sciences, Professor G. Gryaznov to comment on this operation in space and on prospects for the advancement of this new direction in power engineering.

"Development of space nuclear power plants is a fundamentally new direction of power engineering and a vivid example of the interdisciplinary character of contemporary science and technology," said the scientist.

Gryaznov emphasized that painstaking work on problems of radiation safety was already in progress when plans for using nuclear power plants in space were in the discussion stage. If a nuclear power plant is intended for use in a low orbit, safety is ensured by shifting the spent plant to an orbit of prolonged duration (about 300 years), where its radioactive materials will in fact be entombed after the satellite has completed its program.

The use of nuclear power plants in radiation-safe orbits opens up broad prospects for introduction of nuclear power in spacecraft intended for economic purposes.

Nuclear power plants could play an important part in interplanetary flights. According to estimates which Soviet specialists have made, a multimegawatt nuclear plant can create the exhaust thrust which a spaceship need in a flight to Mars.

Footnotes

1. See the DAILY SNAP, October 14,1988, p 1, col 2.

Institute's Radiation Monitoring of Ignalina Nuclear Station

18610144 Vilnius SOVETSKAYA LITVA in Russian No 242, 20 Oct 88 p 3

[Text] Extract: A sector on the environment of nuclear power stations is operating at the Lithuanian Academy of Sciences' Institute of Physics. This sector is studying effects which nuclear stations produce on the environment, continuously conducting radiation-ecology observations and measuring the concentration of radionuclides elsewhere in the republic. ELTA correspondent A. Mankyavichyus talked with Rimvidas Yasyulenis, head of this department.

[Yasyulenis] "Our sector was founded in connection with an increase of the volume of work in line with a republic large-scale program for ecological research of the Ignalina Nuclear Power Station's environment.[1] Other institutes of the republic Academy of Sciences are also working in line with this program.

"In accordance with results obtained at the station, we are calculating, with the aid of a computer, how radioactive substances spread, where they fall to Earth and into Lake Drukshyay within a radius of 10 kilometers, and how much of this fallout enters the soil together with precipitation. The computer's calculations are confirmed by periodically conducted measurements of gamma radiation of radioactive inert gases which are expelled through pipes of the nuclear power station to various points on the station's leeward side. In this manner we evaluate changes of ionizing radiation occurring over a prolonged period of time in the air, on land, in water and in animals and plants.

"Next year, after equipping up to 10 permanent observation posts within a radius of 3-5 kilometers around the station and combining them with stations which are now in operation, we will be able to obtain extra-precise information quickly and effectively."

[SOVETSKAYA LITVA] "You have been conducting research around the nuclear power station for 10 years. What changes in radiation have you noticed during this period?"

[Yasvulenis] "Deposits of radioactive isotopes of iron, chromium and cobalt are accumulating in quite small amounts in the silt of Lake Drukshyay. We are also detecting radioactive isotopes of cesium in plants. These isotopes were carried here from Chernobyl and present a particular danger because of their longevity.

"At a measuring station of ours which is located at one of the most hazardous points of the territory surrounding the nuclear power station, the dose of radiation which formed in 1987 was one-tenth of the permissible norm."

[SOVETSKAYA LITVA] "Is the amount of radioactive substances which the station expels into the atmosphere therefore quite small?"

[Yasyulenis] "If the station is operated without violating any rules."

Footnotes

1. See also the DAILY SNAP, September 15, 1988, p 3, col 1.

UDC 621.43

Generalized Criteria of Efficiency of Independent Mobile Power Generating Units

18610407 Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 3, Mar 88 pp 157-160 (manuscript received 12 Feb 87)

[Article by Candidate of Technical Sciences Yu.A. Garkusha and Doctor of Technical Sciences Professor B.T. Yerokhin; the first paragraph is the article summary]

[Text] The article presents theoretical substantiation of generalized criteria of efficiency of various types and sizes of independent mobile power generating units and gives methodological recommendations for practical application of these criteria.

At present, the problem of development of generalized criteria, which make it possible to reduce the scope of application of a nonformalized and labor-intensive method of expert assessments when comparing efficiency of competing models of industrial products, becomes ever more urgent. We have made an attempt to theoretically substantiate such criteria as they apply to independent mobile power generating units (IMPGU) used in the national economy as power supply systems for independent mobile power generating plants and stand-alone compressor stations, as well as for a number of other machines and mechanisms.

It is well known that power resource of an IMPGU and the possibility to transport it to the point of operation depend to a large extent on the amount of fuel it stores and its mass and overall dimensions. Reducing IMPGU cost is very important too. One must first of all take into account these considerations when substantiating generalized criteria of efficiency of various types and sizes of IMPGU. The substantiation presented later uses certain methodological provisions of cost-benefit analysis, which is ever more widely used in certain industries for revealing resource-saving reserves in product manufacturing and operation.

From cost-benefit analysis methods,[1, 2] any object under development or consideration, including an IMPGU, can be considered a functionally organized system designed for performance of a useful action or a set of such actions. Technical solutions that can be used in IMPGU development are very versatile. However, the users (customers) are usually interested in the functions IMPGU must perform, rather than in these technical solutions or in IMPGU as such. This fact makes it possible, when evaluating IMPGU efficiency, to so to speak abstract oneself from the actual unit and concentrate on its end purpose and expenses. Using a soct-benefit approach, one can subdivide the expenses into two groups:[1, 2] functionally necessary expenses, which cannot be avoided in principle during the development and operation of a technical system for a given purpose, and additional expenses, which are useless (not mandatory, extra) for performing the required functions.

Both groups are also present in functioning of all real-life IMPGU. Thus, functionally necessary energy expenses E_φ are expenses which cannot be avoided even when the overall energy efficiency of an IMPGU is equal to 1, whereas additional expenses are those caused by energy losses during IMPGU operation. Functionally necessary expenses, the theoretically minimal mass M_φ, volume V_φ and cost C_φ of the E_φ energy source are derived from the following expressions:

$$M_\Phi = E_\Phi/Q_т; \quad V_\Phi = E_\Phi/(Q_т \rho_т); \quad C_\Phi = E_\Phi s_т/Q_т,$$

where $Q_т$, $\rho_т$, $s_т$

is average amount of energy released by a unit of mass of working medium (fuel), its density, and the cost per unit of mass, respectively.

Assuming strictly constant unit values of parameters-

$$Q_т = Q_{т_э} = 1; \; \rho_т = \rho_{т_э} = 1; \; s_т = s_{т_э} = 1,$$

which correspond to a standard fuel, we can conventionally consider design values of M_φ, V_φ and C_φ as mass, volume and cost of a hypothetical standard (ideal) IMPGU, wherein all its matter is the source of the energy E_φ and overall efficiency and density of packing are equal to 1. We understand density of packing to be the ratio of fuel volume to the overall volume of the IMPGU.

A hypothetical standard IMPGU corresponds to the theoretical limit of functional perfection. We can consider its design mass M_φ, volume V_φ and cost C_φ as a kind of standard measures. Comparing mass M, volume V and cost C of a real-life IMPGU (with fuel) designed for the same value of E_φ, one can assess its mass YM, volumetric YV and economie YC efficiency using the following expressions:

$$Y_M = M_\Phi/M = E_\Phi/(Q_{т_э} M); \tag{1}$$

$$Y_V = V_\Phi/V = E_\Phi/(Q_{т_э} \rho_{т_э} V); \tag{2}$$

$$Y_C = C_\Phi/C = E_\Phi s_{т_э}/(Q_{т_э} C). \tag{3}$$

The higher YM, YV and YC, the higher the levels of IMPGU mass, volumetric and cost efficiency. When calculating relative efficiency levels of two different IMPGU, formal standard parameters

$$Q_{т_э}, \; \rho_{т_э}; \; s_{т_э};$$

in criteria (1)-(3) cancel out and do not affect the results of comparative assessment of the IMPGU. This demonstrates the objective character of the derived criteria and the

possibility to use them for comparative assessment of various types and sizes of IMPGU without using a nonformalized and labor-consuming method of expert assessments. It should also be noted that the necessary mass M_φ, volume V_φ and cost C_φ of the standard IMPGU are determined on the condition that its reliability is equal to 1. At the same time, after calculating mean values of M, V and C, taking into consideration the probability of incurring additional expenses due to replacement of certain parts and performance of other repair and restoration work in cases of failures of real-life IMPGU, one can, if necessary, assess IMPGU efficiency, while taking into account its reliability, using the same generalized criteria (1)-(3). In the general case, parameters M, V and C can also be assessed taking into account other types of additional operating expenses.

The value of functionally necessary energy expences E_φ depends on IMPGU useful work and can be derived from the following expression:

$$E_\Phi = \int_0^T N_e(t)\, dt = m_т Q_т \eta_i. \tag{4}$$

where Ne(t) is IMPGU effective power at moment t; T is the time of IMPGU operation until all fuel is used up; η is mean integral IMPGU efficiency during time T; and mT is the mass of fuel stored in the IMPGU. The form of function Ne(t) and time T depend on the IMPGU operating mode. During downtime this function is assumed to be equal to 0. When determining required values of mass, volume and cost of a real-life IMPGU, the design case is, as a rule, its operation in the maximum capacity mode. Therefore it is expedient to assess IMPGU efficiency for this case.

It has been noted earlier that, when comparing various IMPGU, the choice of specific values of formal standard parameters does not affect the results of determination of relative levels of their mass, volumetric and cost efficiency. Therefore, in order to simplify practical calculations and criteria recording, it was convenient to use unit values

$$Q_{т_э},\ \rho_{т_э},\ s_{т_э}.$$

In this case, taking into account (4), criteria (1)-(3) can be presented in the following form:

$$Y_M = \frac{m_т Q_т \eta_i}{m_т + m_к} = \frac{Q_т \eta_i}{1 + z}; \tag{5}$$

$$Y_V = \frac{\rho_т V_т Q_т \eta_i}{V} = \rho_т Q_т \psi \eta_i; \tag{6}$$

$$Y_C = \frac{m_т Q_т \eta_i}{C_т + C_к} = \frac{Q_т \eta_i}{s_т + s_к z}, \tag{7}$$

where VT and CT are IMPGU volume and cost of fuel; mk and Ck are mass and cost of IMPGU structure

$$(m_к = M - m_т,\ C_к = C - C_т);\ z = m_к/m_т$$

is relative mass of IMPGU structure;

$$\psi = V_т/V$$

is IMPGU packaging density;

$$s_к = C_к/m_к$$

(when calculating YCfor an IMPGU that is refueled several times, the values of Ck and sk in (7) must be divided by the number of refuelings).

Generalized criteria (5)-(7) include all basic partial indices used in assessing the efficiency of fuels and IMPGU structures. Using these generalized criteria, one can assess and compare the levels of mass, volumetric and cost efficiency of various types and sizes of IMPGU at the design stage and during project quality certification. Statistical data that characterize annual changes in YM, Y and YC (as new developments come out) can be used for forecasting trends in imrpovement of these indices in the future, in order to substantiate requirements for specicification that call for the development of advanced IMPGU at the level of the best world models. Criteria (5)-(7) can also be used for assessing efficiency of various design versions when optimizing IMPGU in CAD systems.

Conclusions

1. The article presents theoretical substantiation of generalized criteria which make it possible to perform direct quantitative assessment and comparison of mass, volumetric and cost efficiency of various types and sizes of independent mobile power generating units.

2. The proposed generalized criteria can be used in design research and in design quality certification of independent mobile power generating units.

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UDC 621.865.8

Robotics, Automation Adoption Philosophy Analyzed
18610160 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 88 pp 31-33

[Article by L. I. Volchkevich, doctor of technical sciences, under the "Problems of Robotization in Machine Building" rubric: "Work Without Jobbing"]

[Text] There is every reason to suggest that the coming decade will be a transitional stage in the development of technology—a dividing line between the eras of nonautomated and automated production. And it is precisely now that, on the one hand, a very pressing social need for such a change has developed and, on the other, the scientific-technical prerequisites for the appearance and development of much of the latest automation equipment have come about.

The appearance and development of industrial robots has without a doubt been one of the biggest achievements of science and technology in the past few years. The appearance of industrial robots made it possible to expand the front of operations to automate production and auxiliary processes and opened broad perspectives for creating automated machine systems for flexible readjustable production.

With the initiation and development of robotics it became possible to escape a period of mistrust and underestimation. A great deal of attention was placed on the development and introduction of industrial robots. Within a short period of time an entire network was created of specialized enterprises and organizations in many ministries that are concerned with designing and constructing robots in our country. Thus, about 6000 industrial robots were produced in the entire 10th Five-Year-Plan, whereas 15,400 were produced in 1986 alone. Production of industrial robots is slated to increase even more in the 12th Five-Year-Plan.

It seemed as if the combination of unrestricted interest in progress and increased attention should ensure that industrial robots would make a substantial contribution to accomplishing the tasks entailed in intensifying production. This did not occur, however. On the contrary, the move to robotize production is now experiencing a difficult period characterized by a discrepancy between the efforts and means being expended and their real yield. And this has bene caused not by any unexpectedly discovered shortcomings of industrial robots but rather by admitted miscalculations in the implementation of robotization policy, both in our country and abroad.

According to an analysis done in England in 1985, 44 percent of firms involved in robotizing production spoke of their failures. This figure seems low because far from all firms admit their failures. Half of the specified firms stated that they were temporarily halting their operations to robotize production. Analogous examples have appeared in the domestic press. It appears that this situation has resulted from a whole complex of objective and subjective factors.

The beginning of a fundamentally new scientific-technical field, with its inevitable difficulties and failures, is underway. Industrial robots have too short a history to have only advantages and no shortcomings in their design and practical application.

But this is not the only point. For a long time industrial robots were viewed not from the standpoint of a real means of increasing production efficiency but rather only as the equivalent to replacing human beings in production and as a means of freeing humans from monotonous and strenuous, uninteresting manual labor. It is this very concept of the industrial robot as an "iron man" with powerful muscles and a high-power electronic brain that does not walk around and does not need a place to live and that works around the clock all year round that has run like a red thread through a great number of enthusiastic speeches and publications.

This beautiful legend, which promised to immediately free all workers from manual labor and to free managers from a multitude of worries and difficulties, seemed unusually enticing at the time. All problems would be solved. All that remained was to acquire and introduce industrial robots. This legend was skillfully stimulated abroad by certain foreign firms, especially Japanese, that had no little investment in organizing the production of industrial robots, and it was sustained by our mass media. Under conditions of this kind of jobbing, it took more than a small amount of daring to state a different point of view.

The "humanization" of industrial robots played a positive role in the early stages of robot construction thanks to the simplicity and clarity with which they could be discussed, especially for those who did not have any in-depth knowledge of production technology but who did have the right to make decisions. This helped establish a new direction and accelerated the development of the first designs. As a consequence, however, once the wide-scale introduction of industrial robots into production began, it was precisely the concept "robot replaces man" that separated robots from the other resources in the production arsenal and that was the source of today's multitude of difficulties and failures.

In the first place, this concept is deeply erroneous in its essence. A robot cannot replace a human being. A human being can only be replaced by another human being, one, we hope, who is stronger, more qualified, and more conscientious. Of the unimaginable diversity of human functions and capabilities in the production sphere, industrial robots, as they exist today, are only capable of assuming those roles that do not radically exceed the capabilities of such traditional and long-existing pieces

of mechanization and automation equipment as belt transporters, vibratory loading devices, and ordinary manipulators with cyclic control. Moreover, all of the benefits that have been attributed to industrial robots are common properties of all technical equipment. For example, a belt transporter also replaces a human being, freeing him from heavy manual labor. A transporter does not walk around, does not require an apartment for his family or a place in the kindergarten. But nobody ever used similar arguments to justify using the specified transporter versus a chain conveyer, for example. Not one vibrating discharge hopper has been said to upset labor discipline.

Why then, when these arguments have been used in reference to industrial robots, have they moved and enticed so many people?

The idealized conceptions of industrial robots that have evolved—that they are somehow capable of completely replacing people in production and that they will make it possible to carry out a technological revolution and rebuild the very foundations of industrial production in a very short period of time—do not reflect the real state of affairs. The mass introduction of robotized systems at a rapid pace has in many respects destabilized industrial production and has given rise to more than a few serious problems. This has happened because the real capabilities of industrial robots were exaggerated and because several prototype examples were taken as typical robots.

This incorrect notion of robotization, gearing it toward simulating certain manual actions of humans in the naive hope that everything else will follow instead of gearing it toward solving the fundamental problems of production efficiency (quality, productivity, cost-effectiveness), is not as harmless as it might seem.

In the first place, this notion is only one step away from robotization for the sake of robotization itself and thus disappointment because the harsh dictates of production inevitably cause the expensive, slow-running and unreliable designs to be jettisoned. In the second place, the developers themselves, having followed an incorrect idea when creating robots and manipulators, are beginning to look for the easiest rather than the most efficient paths.

From the standpoint of increasing production efficiency, different types of robots are far from being of equal value. Using robots in welding, painting and galvanic coating operations, etc., makes it possible to increase production quality substantially, primarily by stabilizing production modes. The productivity of equipment is increased thanks to the dexterity, speed, and increased load-lifting capacity of robots. People are completely removed from the worksite and freed from having to work in an unpleasant environment.

At the same time, industrial robots have no effect on product quality when used to load metal-cutting machine tools. From an equipment productivity standpoint, there is usually a loss. This is because it is generally faster to load ordinary components manually. Gains, albeit slight, can only be achieved relative to the wage fund because one worker can service two to three NC machine tools ,and without any robotization. Then why have the overwhelming majority of developments up to now been addressed toward loading metal-cutting machine tools or presses, i.e., the least promising directions, instead of toward welding, painting, and galvanic production? There is only one answer: if one approaches robotization solely as a task of simulating human actions, then it is simpler, easier, and more convenient.

Potentially efficient at the present time are, first and foremost, robots for spot and seam welding, including welding in the auto industry. But here too experience tells of the difficult and complicated process of increasing robots' mobility, speed, and operating reliability, all of which must be increased before their potential capabilities can become a reality.

Compared with traditional continuous production and automated welding lines, in the auto industry robotized complexes can significantly increase the operating flexibility of equipment, i.e., when making the transition to the production of any new model motor vehicle, it would in principle be sufficient to make the necessary changes in the program controlling the robots' operation. In reality, such flexible systems still do not exist. At the present time, robotized complexes are capable of producing only a very limited number of types of products. For example, a qualified worker needs only several seconds to switch from one production operation to another, whereas reprogramming an industrial robot, even that related to restarting production of an earlier-model motor vehicle but with a different type of body, is a rather complicated process. Real progress in this field is occurring with respect to the launching of the production of a new generation of industrial robot with a significantly larger memory and the development of advanced programming languages. There need only be the slightest malfunction in a single robot and work on the entire line is halted. It is therefore no accident that at the end of each conveyer line that makes it possible to replace one failed robot or another. Similar actions, which result in increases in the percentage of manual labor in robotized sections of up to 30 to 40 percent, often cause serious problems.

For a long time, the majority of industrial robots were created as floor model designs, which was either a conscious or unconscious imitation of a person standing on the floor while working. According to our data, floor model industrial robots account for 53 percent of the total number of industrial robots. Yet another 39 percent are fastened to base equipment subassemblies, and only 8 percent have a suspended design (gantry, etc.).

Nevertheless, floor model industrial robots are the most inefficient and uneconomical because they require significant auxiliary areas, are a source of psychological stress to humans performing remaining adjustment and service operations, and afford minimal possibilities of servicing multiple machine tools at the same time. And industrial robots can operate "head first," which is even better.

The fact that specialists from the fields of computer technology, engineering cybernetics, etc., who had little prior experience in areas related to automating production, initially played a leading role in the creation of industrial robots undoubtedly affected the success of robotization as a scientific-engineering field. They sincerely believed that the main thing was to create a robot design and above all a control system for the robot and a complex of control programs for manipulation processes simulating human action. But such an approach turned out to be erroneous. The aforementioned analysis of English firms showed that among firms that had successfully introduced robotization, 83 percent had already had experience in automating production by using other equipment. On the other hand, only 25 percent of the firms that had difficulty in introducing robotization had any such prior experience.

The currently existing opinion that automating production can be reduced to robotizing it is wrong because it assumes that production processes and machine designs and components will essentially remain at their previous level and that only a robot can reduce the number of service personnel.

Any production process consists and will continue to consist of production processes for obtaining materials, processing those materials, and inspecting and assembling products which make up machine designs and components, devices, and systems of devices. It is precisely here that all potential for improving the quality and quantity of production and its economic efficiency lie. No automation or robotics can yield more than lies within the technology itself.

The limited nature of material and human resources is one of the facts of the contemporary stage of scientific-technical progress. Under such conditions it is necessary to give preference to the development of those items that yield the greatest socioeconomic effect given existing capabilities.

In the strategic plan this means returning to top-priority robotization of those production areas where comprehensive results can be obtained by using progressive technology, i.e., using new methods and processes, concentrating operations, and using multiposition and multitool processing or assembly.

In the tactical plan this means that it is necessary to avoid distributing robotization hardware that does not yield high end results or results that appear one-sided, for example, results that only reduce manual service time. All efforts must be concentrated on raising the technical level of industrial robots as quickly as possible, i.e., on increasing their speed, reliability, positioning stability, mobility during readjustments, etc., and only posing questions concerning production quantity in relation to the quality level achieved.

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Structure of Flexible Manufacturing Systems

18610406c Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 88, pp 12-15

[Article by Candidate of Technical Sciences V.F. Krasnikov under the rubric "Means for Mechanization and Automation"]

[Text] A flexible manufacturing system (FMS) consists of process equipment and a system for ensuring its functioning in an automatic mode, and can be set up automatically when manufacturing an arbitrary output product mix, within specified limits of their parameter values. Block diagrams of eight real-life FMS and flexible manufacturing modules (FMM) are presented in Table 1.

At Rostselmash PO [production association], a flexible manufacturing system developed by the Planring company (FRG) has been implemented. It is designed for complete machining of five types of auger shafts and six types of drive shafts of grain harvesters. The products consist of three groups of parts: a) journals, b) shaft-arbors, and c) a spiral screw conveyor. Drive shafts are assembled from parts in groups a and b, auger shafts - from parts in groups b and c.

Structurally, the FMS consists of two flexible sections: I - machining of journals, and II - assembly and electron-beam and laser welding of auger and drive shafts.

When setting up the FMS for another type of journals, the setup time for the automated sorting machine and gantry robot is 45 minutes. A computer records the filling of pallets and controls the emptying and interim storage thereof until the next filling cycle. Assembly and disassmebly of all pallet stacks is done by computer-controlled stacking cranes. In rack cells, a backlog of blanks must be available; they are also used for interim work-in-process storage. Each cell has a code field where blank position is coded.

In case of computer failure it is possible to control FMS equipment in a manual mode.

To change the type of journals one must do the following: record the machining program on a tape; change or readjust face dogs and the tailstock; change tooling; set

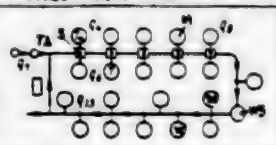
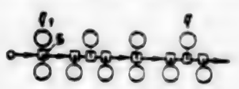
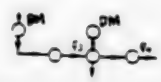
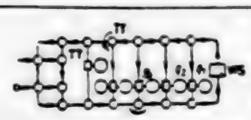
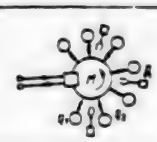
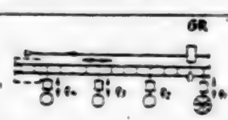
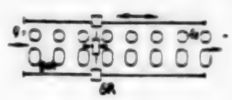
	Organization	Structural Diagram	Product Mix (Type of Product)	Quantity (Type of Processing)	Number of Process Machines	Type of Transport	Structural Formula	Storage	Control System
1	PLANRING (FRG), ROSTSELMASH PO (USSR)		11 (R)	12 (T, D, M, W)	34	T GR O	S (34, 34)	S	computer
2	ENIMS (USSR)		16 (R)	10 (T, D, M)	10	M TA	S (10, 9)	S	computer
3	AZOV Special Design Bureau (USSR)		90 (S)	2 (S)	4	O	S (5, 4)	S	μcomputer; Controller
4	BUTLER (England)		12 (R, S, H)	1/4 (T, D, M, TC)	1	P, TP	S (1, 2)	S	μprocessor
5	CINCINNATI (USA)		24 (H)	6 (B)	7	Tp P RC	S (7, 12)	S	comput
6	ROTA F125NC (GDR)		14 (B)	7 (T, M, B)	7	T R M	S (7, 8)	S	computer
7	HELLER (FRG)		12 (H)	4 (M, B, D)	4	P GR	S (4, 3)	S	μcomputer
8	FUJI FANUC (Japan)		24 (R)	8 (T)	8	GR	S (8, 7)	S	computer

Table 1

Key: q - process machines; R, S, H and O stand for solid-of-Revolution parts, Sheet parts, Housings, and Other parts; T, D, M, B, TC, S and W stand for operations: Turning, Drilling, Milling, Boring, Thread-Cutting, Stamping and Welding; for materials handling systems, T - trucks, P - palletized, and GR - gantry robot; TA - transfer arm, RC -roller conveyor, M - manipulator-serviced magazine, BM - blanks magazine, DM - die magazine, TM - tool magazine, R - robot, C -clamshell device, and O - other types of material handling systems; S -intermediate storage, TT - turntable, WS - washing station.

the measurement module to a different dimension; enter the program into the loading device; and set up or change the grip of the gantry manipulator. The setup takes 30 minutes, and its conclusion is indicated by an indicator located on the machine.

Milling of keyseats is done on 10 horizontal two-spindle CNC keyseat milling machines and a single-spindle horizontal milling machine.

Programs for machining journals of all sizes are stored in a milling machine memory, so to change the type of journals one has to change the position of a selector switch.

Drilling of two radial holes is only necessary for one type of journal and is done on a special four-spindle machine. Loading and unloading are done with a gantry crane.

All machine tools that perform lathe operations, slot contour facing, slot milling, hole drilling and milling of keyseats and flats are connected to a centralized system for distribution of lubricating and cooling fluid (LCF). A deep drilling machine, which performs the first face machining operation, has an individual LCF feeding system. All facers and lathes are equipped with chip removal systems which transport chips and LCF to

side-mounted containers. In keyseat milling machines, chips are removed by hydraulic washing via nozzles into a collection box located in the center of the machine and equipped with a conveyor with chip catchers. Chips are ejected at the end of the central chip conveyor into a receiving container. Emulsion and LCF are collected in a central 30-m^3 tank, where they are cleaned in cyclones.

Flexible automated section II performs assembly and welding of screw conveyors and drive shafts. Two welding methods, electron-beam and laser, are used.

The FMS has a degreaser. Journals are degreased together with pallets. The degreasing chamber is hermetically sealed, so there are no harmful effluents. Degreasing is performed in two stages: dipping (rough cleaning) into cold perchlorethylene and steam degreasing at 120 °C. Heating is done by saturated steam. Exhaust air and vapors are scrubbed.

Welding of four types of drive shafts is done on electron-beam welding units. Degreased journals are delivered on pallets to the welding position. The gantry robot places two journals into holders provided in the welding unit. A cross-feed mechanism delivers a shaft from intermediate storage, and the gantry robot places it in the welding unit. After all parts have been brought to the vacuum chamber gate, it turns 180 °, and parts enter the welding chamber. Within 30 seconds vacuum is created in the chamber. This time is enough to remove the finished shaft from the chamber and feed in new parts. Average time per piece is 60 seconds. The setup consists of changing journal and shaft holders and clamps and adjusting longitudinal stops on carriages.

There are following limitations to the FMS operation: journal mass should not exceed 20 kg; journal size should not exceed the pallet size; carbon content in journal and shaft material should not exceed 0.45 percent. The control computer is developed by the Siemens company (FRG).

FMS production rate is 35-40 parts per hour at utilization factor of 0.8.

The multitude of FMS structures and layouts can be divided into two basic types: linear (acyclical) and closed (cyclical), depending on the routing of parts in the horizontal plane through workstations between intermediate storage and other links of the system. In addition to main movements, layouts provide additional paths (transverse lines and side branches). Other features are also available, such as, for instance, placing workstations in or aside from the main traffic line. In this case, workstations are connected to the line by means of infeed devices also used as buffer storage. Types of FMS structures, conveyor traffic directions, workstation location relative to the conveyor and the character of connections between the workstations are presented in Table 2.

Table 2

Type of FMS structure	Traffic direction	Workstation position	Workstation sequence: Fixed, no skipping	Fixed, some skipping; semiflexible	Flexible	Feasibility of this version	Flexibility ratio	Structure number per Table 1
Linear (acyclical)	One-way	In the traffic line	1	0	0	1	0.33	3;4
		Aside from the traffic line	1	1	0	2	0.67	2;6
	Two-way	In the traffic line	0	0	0	0	0	-
		Aside from the traffic line	1	1	1	3	1	7;8
Closed (cyclical)	One-way	In the traffic line	1	0	0	1	0.33	-
		Aside from the traffic line	1	1	1	3	1	1
	Two-way	In the traffic line	0	0	0	0	0	-
		Aside from the traffic line	1	1	1	3	1	5

Legend:
1 - possible;
0 - impossible

Structures 3 and 4 in Table 2 are in essence structures of automated lines with fixed connections and no skipping of workstations. When workstations are located aside from the traffic line (structures 2 and 6), then in one-way traffic any given sequence of going through the workstations is possible.

Flexibility of structures 3 and 4 is K_f=0.33. Module flexibility is provided by changing the setup of the process equipment, and by programmed control and changeable fixtures.

Flexibility of structures 2 and 6 is K_f=0.67 and is provided by placing equipment aside from the traffic line and by having intermediate storage next to the machine tools.

In the case of two-way traffic, a linear layout (structures 7 and 8) and closed structure (structures 1 and 5), any sequence is possible. Structure 1 is realized in the Rostselmash PO FMS. Strucutre 5 is used in the Cincinnati (USA) FMS. In the so-called circulation system of this FMS, pallets circulate continuously along the line until they are taken off at the proper positions (see Table 1).

Quantitative assessment of flexibility of a machine system is done based on flexibility matrix Z, wherein process machines q_i (elements of the set Q) are the columns, and the parts z_i machined in the system are the rows; the matrix elements z_{ij} denote two states: 1 - the machine is used for machining in accordance with this technological process; 0 -it is not used;

$$Z = \begin{array}{c|cccccc|} & q_1 & q_2 & \dots & q_j & \dots & q_m \\ z_1 & z_{11} & z_{12} & \dots & z_{1j} & \dots & z_{1m} \\ z_2 & z_{21} & z_{22} & \dots & z_{2j} & \dots & z_{2m} \\ \vdots & \dots & \dots & \dots & \dots & \dots & \dots \\ z_i & z_{i1} & z_{i2} & \dots & z_{ij} & \dots & z_{im} \\ \vdots & \dots & \dots & \dots & \dots & \dots & \dots \\ z_n & z_{n1} & z_{n2} & \dots & z_{nj} & \dots & z_{nm} \\ & \Sigma z_{i1} & \Sigma z_{i2} & \dots & \Sigma z_{ij} & \dots & \Sigma z_{im} \end{array} \qquad (1)$$

Summing the values of coefficients by column ,

$$\sum_{i=1}^{m} z_{ij}$$

one can quantitatively assess technological flexibility of each machine in a system. It is expedient to assess equipment flexibility in relative values, equipment flexibility factors:

$$K_{r.o} = \frac{\sum_{l=1}^{n} z_{kl}}{\Sigma z_{ij}}, \qquad (2)$$

where $\sum_{l=1}^{n} z_{kl}$

is the sum of coefficients in column j of the matrix and Σz_{ij} is the sum of coefficients provided the machine is used for machining all n parts.

Using expressions (1) and (2), we shall now determine technological flexibility of FMS equipment. Six types of shafts z_n (n=1...6) are machined using the automatic machines and machine tools as denoted along the top row of the matrix:

$$Z = \begin{array}{c|cccccccc|} & q_1 & q_4 & q_6 & q_7 & q_8 & q_9' & q_{10} & q_{11} \\ z_1 & 1 & 0 & 1 & 1 & 0 & 1 & 1 & 1 \\ z_2 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\ z_3 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \\ z_4 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\ z_5 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\ z_6 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\ K_{20} & 1,0 & 0,83 & 0,16 & 1 & 0,66 & 0,33 & 0,16 & 1,0 \end{array} \qquad (3)$$

One can see from the matrix that automatic machine q_1, machine tools q_7 and washer q_{11} have the highest flexibility K_{20}=1, whereas machine tools q_5 and q_{10} have the lowest flexibility K_{20}=0.16. The flexibility factor of the entire system is equal to the mean value

$$K_{20}^{c} = \frac{\sum_{1}^{6} K_{20}}{6} = 0,86.$$

System flexibility is its adaptability to dynamic and stochastic perturbations related to the plant production schedule. A system is flexible if its structure does not change when production schedule changes. As an economic measure of flexibility, it is suggested to use the ratio of expenditures for changing the system setup to depreciation expense during operation prior to changing the setup. Flexibility K_2=1 if no additional expenses are required when changing to machining a new product.

The main stage in FMS development is selecting a rational structure, which must ensure that the process equipment is adequate for meeting the production target. Flexibility of a production system is an integrated parameter; it is determined by flexibility of technology, structure, technological and material handling equipment, tools, industrial robots and other equipment. In order to ensure FMS flexibility, linear and closed structures are recommended, with workstation location aside from the main product flow and with space allocated to interim work-in-process storage, buffer-type storage, side

branches and sites next to machine tools. Equipment flexibility is determined by its technological capabilities, the number of programs that can be realized and the number of spindle heads installed, and is quantified by the flexibility factor.

UDC 621.8.65.8

Specific Features of Automated Control of Technological Processes of Electromachining

18610406b Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 88 pp 10-12

[Article by Candidates of Technical Sciences V.V. Atroshchenko and V.I. Polyanin under the rubric "Means for Mechanization and Automation"]

[Text] Operations such as shaping a surface of complex geometry, cutting channels with an aerodynamic profile, broaching very small size holes and slots, making connecting channels etc., are almost impossible to machine in hard-to-reach places and in parts made of high-strength and heat-resistant steels and alloys.

These operations can be performed efficiently if one uses shaping methods called electrophysical and electrochemical dimensional machining processes, or in short electromachining processes. The main advantage of these processes over machining is independence of technological parameters on physico-mechanical properties of treated materials, such as hardness, ductility and thermophysical characteristics.

Automated control of electromachining technological processes based on flexible manufacturing modules (FMM) requires solving a number of problems not typical in the control of machining processes: short circuit protection of the electrode/tool and electrode-/blank, as these result in erosion of contact surfaces, and more stringent requirements on the noise rejection of NC devices, because of the presence of powerful electric discharges and currents up to several tens of thousands of amperes.

From the standpoint of FMM-based control, one can consider electromachining processes as an single complex dynamic control object. The indivisibility is a result of the common physical nature of the processes: in all cases shaping is based on introduction and transformation of electric power in the space between electrodes, where a fluid is being pumped through. These processes are also characterized by noncontact material removal; simultaneous ongoing interrelated electric, hydrodynamic and kinematic processes; dependence of the removal mechanism on the dielectric properties of the fluid; getting rid of the machining by-products (anodic solutions and/or electric erosion from the inter-electrode region) by the flow fluid; and irreversibility of shaping (it is impossible to restore what has been removed).

The complexity is due to the presence of a large number of control actions and disturbances (uncontrolled actions), absence of a priori information on dynamic characteristics of the proceses, and nonsteadyness and nonlinearity of static and dynamic characteristics of the object of control.

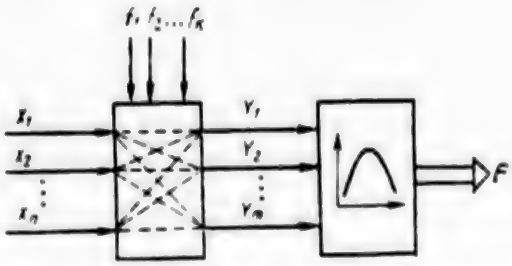


Figure 1. Block Diagram of Electromachining Processes

Figure 1 shows a block diagram of electromachining processes as a generalized control object presented in the form of a series connection of a dynamic and a static link. Here, X1, X2, ..., Xn are control actions, Y1, Y2, ..., Ym are controlled values in the dynamic link of the control object, f1, f2, ..., fk are disturbances in the dynamic link, F is state vector of technological parameters (accuracy, production rate, surface roughness, electrode/tool wear and the depth of the changed layer of the electrode/blank). X and Y parameters are common to all processes. These are control actions (electrode/tool feed speed V, power supply voltage U, and the characteristics of the fluid entering the inter-electrode region), and controlled parameters of the control object's dynamic link (the gap between electrodes S, current i between electrodes and the characteristics of the fluid as it leaves the inter-electrode region).

When studying electromachining processes as an single object of control, one should keep in mind the commonality of control actions and output values of the dynamic link. One can see that n = m = 3, i.e. the control object is a three-dimensional multiply-connected object. Disturbances that act on inputs of the control object dynamic link depend on specific features of the process that is being realized (properties of the fluid, the technological methods of machining, etc.).

The order of the static link over the entire set of electromachining processes is not less than 2, and the link is extremal in nature, i.e. in all cases of controlling electromachining processes the objective of control is to extremize a certain technological parameter while placing limitations on all others. In the general case, the

target functional of control of electromachining processes is to determine and maintain the maximum production rate while placing limitations on technological parameters such as accuracy, surface roughness, electrode/tool wear, etc.

The states of the generalized control object are characterized by a set of factors which, unless computer technology is employed, are impossible to continuously measure and process, and to select control actions.

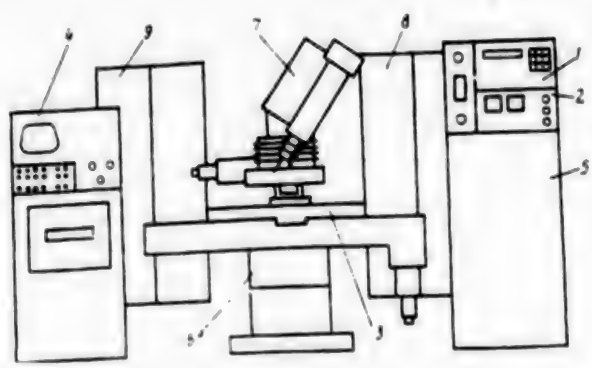


Figure 2. Electromachining FMM

Figure 2 shows an electromachining FMM. The module includes integrated circuit 1 for automatic control of electromachining processes, a system 2 for automatic short circuit protection of electrodes, multicoordinate (3 to 6 coordinates) machine 3 with CNC devices (2S-85, 2S42-65) 4, programmable power supply 5, system 6 for changing the properties of the fluid (SISRZh), tool magazine 7, electric drive panel 8 and control panel 9.

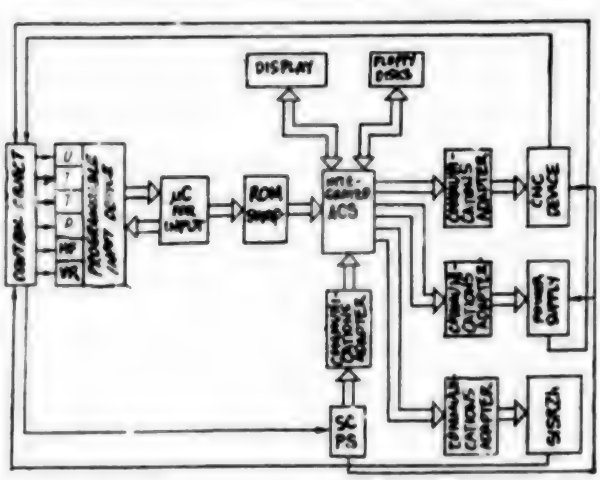


Figure 3. Block Diagram of Integrated Automated Control System

The main element of an electromachining FMM is the integrated automated control system (Figure 3). The lower control level includes adapters for communicating with ACS [automated control system] actuators: a CNC device based on an Elektronika 60M microcomputer, a programmable power supply, and a system for varying the properties of the fluid (SISRZh). In addition, there is an Elektronika 60M microprocessor, a programmable input device and an adapter for connecting to the automatic short circuit protection system (SCPS).

The upper level is structured on the basis of a DVKZ interactive computer complex and is designed for realizing a strategy of multiply-connected control of electromachining processes by interaction in real time with the lower level. Peripherals (15 IE-00-013 alphanumeric display and GMD 7012 floppy disk storage device), which are part of the DKVZ, are designed for writing and debugging of software that realizes adaptive algorithms for identification and control of electromachining processes. During the control process the functioning of the automatic system can be temporarily blocked by commands from the system for automatic short circuit protection system via the communications adapter.

The main problem that the integrated automated control system solves is reaching, and maintaining during the treatment, extremal values of main technological parameters, determined on the basis of a limited number of statistically-noisy measured output parameters characteristic of the process, and often very diffuse a priori information. This problem belongs to the class of multiparameter optimization problems; it defines realization of optimum control algorithms (for instance, using the gradient descent method) and is characterized by the determination of an extremum target functional in real time.

The use of a computer makes it possible to realize a single integrated ACS structure common to all electromachining processes, improve the flexibility and quality of control, provide software representation of any control system and hence ensure required values of main technological parameters. As a control computer, it is feasible to use modern microprocessors, characterized by low cost and low power consumption, high speed of response, high reliability and well developed software.

A generalized block-diagram of an integrated ACS should ensure that

- interfacing is possible with any type of FMM that realizes electromachining processes;
- application of the ACS is independent of specific features of the electromachining processes (achieved by hardware organization of the integrated initial data conversion modules);
- there is two-way data exchange between the microcomputer and the integrated initial data conversion modules;

- it solves problems of information control and real-time acquisition and processing;
- there is high reliability and software resistance to hardware malfunctions and failures;
- MTBF is in the hundreds and thousands of hours.

The main requirements on the integrated electromachining process ACS are as follows: high speed (at least 250-500 thousand operations per second), overcontrol (0), at least 1 KB of ROM, at least 15 information parameters that can be processed, and at least three control actions.

Electromachining processes can be characterized by a limited number of common information parameters (15 to 17 - see Table), including instantaneous and mean values of current I and voltage U, rate V_{disch} of current and voltage rise (drop) at moments when electric discharges are initiated, running values of high-frequency voltage spikes, power and time parameters of power pulses, and characteristics of the inter-electrode fluid.

Parameter	Method				
	Electro-chemical machining	Electro-chemical spray	Electric discharge machining	Electric arc [illegible] signal	Electro-chemical/electric discharge
I, A	5—30 000	0,1—2	—	100—150	—
I_{av}, A	1—20 000	—	0,3—500	100—150	1—1000
i_m, A	10—30 000	—	2—2000	—	2—2000
U, V	2—20,0	100—1000	—	20—30	—
U_{av}, V	3,5—800	—	0—150	20—30	20—40
U_m, V	2—100	—	80—300	—	80—200
U_{HF}, V	0,0025—0,08	0,01—1	1—2	1—2	3—5
U_{arc}, V	—	—	25—30	20—30	25—45
R_{fl}, Ω	$0,4—1\cdot10^{-3}$	1000—600	$10—10^{6}$	10^{-6}	20—0,04
f, kHz	0,025—4	—	0,1—800	—	0,400—2 000
τ_i, μs	500—1000	—	0,1—100 000	—	100—2000
τ_f, μs	10—5000	—	0,1—2	—	0,1—800
τ_d, μs	10—8000	—	0—15	—	5—50
N_{xx}, %	—	—	0—100	—	0—100
N_{sc}, %	—	—	0—100	—	0—100
N_{wp}, %	0—100	—	0—100	—	0—100
V_{disch}, V/s	—	—	150—800	—	0,4—1,6

I and U are values of d.c. current and voltage; I_{av} and U_{av} are mean values of pulse current and voltage; i_m and U_m are instantaneous values of pulse current and voltage; U_{HF} is the high-frequency spike voltage; U_{arc} is the arc voltage; $R_{fl}$is the resistance of the inter-electrode fluid; f is pulse repetition frequency; τ_i is the pulse width; τ_f is the pulse front width; τ_d is the duration of breakdown delay; N_{xx} is the number of no-load pulses; N_{sc} is the number of short-circuit pulses; N_{wp} is the number of working pulses; and V_{disch} is the rate of current and voltage rise (drop).

Ranges and the values of derivatives of the above parameters are specific for each electromachining process.

The uniformity of the method of electric action on the machined blank (electric power transformation), similarity of conditions of electromachining processes (they are conducted with working fluid between electrodes) and traditional similarity of technological schemes make it possible to implement, based on FMM, integrated control of the processes and hence provide uniformity of hardware and of software concepts.

Integrated control of electromachining processes based on a common FMM machine tool base makes it possible to organize a generalized technological electromachining process, wherein positive features of each electromachining process are used for shaping the technological appearance of parts.

UDC 621.96.043

Requirements on Shearing Dies of High-Speed Presses

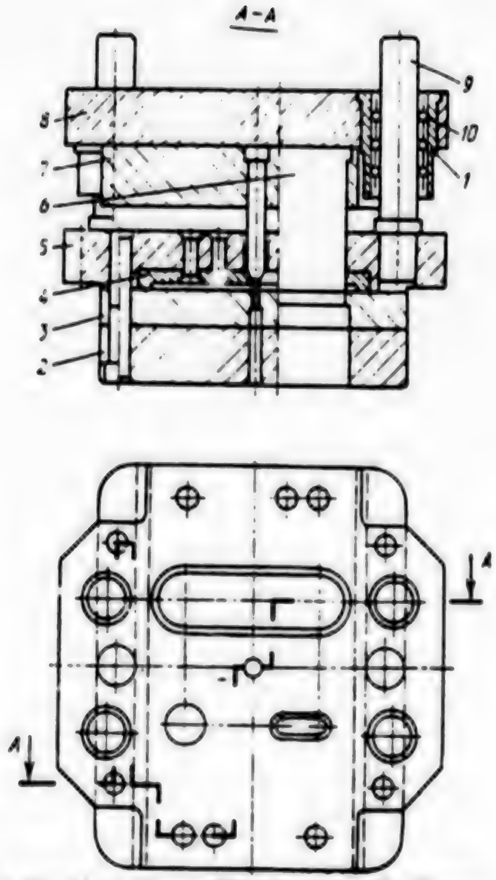
18610013 Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 7, Jul 88 pp 20-22

[Article by I. G. Diner]

[Text] The lack of validated requirements on dies used in high-speed presswork is one of the reasons for the small numbers of high-speed presses.

High-speed presswork can be done on the Soviet universal automatic sheet-stamping presses with regulated number of strokes of 400-1000 kN, models AB6224, AV6228, A6328A, AA6330, and others, and on the Western model PASZ63.3 with up to 1000 strokes per minute. Multiposition block dies are used in these machines. A sizable impact is achieved by using specialized automatic presses with bottom actuator, model SN-138, PA-10, ShA-03, 4GZh, and others, with 100-250 kN force, equipped with precision roll trains of interval error no more than 0.02 mm, which eliminates the need for stepping shears and enables a 5-8 percent reduction in outlay of stamped metal. For these presses, it is possible to use unitized (nonblock) dies, differing from the traditional dies in less metal consumption and lower fabrication labor intensity. The outside clearances of the dies in plan view are 100x80 and 160x140 mm.

The model PA-10 press, furthermore, is distinguished by high rigidity and comes with a device automating the feed of strip to the work zone of the press. This enlarges the performance possibilities of the press, handling material up to 2 mm thick in a strip up to 60 mm wide, and guarantees working safety. The unitized (nonblock) die installed on presses of type PA-10 (Fig. 1) makes it possible to use wider strip, thanks to the outlying columns.



A Nonblock Stamp With Outlying Guidiways.

Key:

1. Guide Sleeve	6. Punch
2. Bottom plate	7. Punch holder
3. Dies	8. Top plate
4. Guide stripper	9. Column
5. Stripper	10. Cage

The punches and dies are made of alloyed tool steel Kh12M, Kh12F1, and hard alloy VK15, VK20, while the plates of the stamp are made of steel 45 and are heat treated to hardness HRC_E 33-39. The guideways, manufactured as per GOST 14676-83, do not provide the required result. One should employ special roll guideways with 2 mm diameter balls. The different gage size of the balls within a cage should not exceed 0.002 mm. The sleeves and plate are fastened by epoxy compound or press-fitted with tightness of 0.005 mm. The stripper 5 in this stamp is not a guide for the punches. On its lower surface is secured a guide stripper 4 (extension), made of steel Kh12M and heat treated to hardness HRC_E 55-59, 5 mm thick, which serves the purpose of a guide. The openings for the punches in this piece are contoured for the working section of the punches with a side clearance of 0.05-0.1 mm. There is a slot for passage of the strip, its height being 0.8-1.5 mm larger than the thickness of the material being stamped, and its width 0.2-0.4 mm greater than the width of the strip.

The thickness of the plates is increased in the multiposition block stamps used on high-speed automatic presses of 400-1000 kN. The die and punches are made of alloy tool steel or hard alloy. As a rule, there is a rigid stripper or a movably suspended stripper[1]. The use of epoxy compounds to form the guide surface is not suitable, due to the high coefficient of thermal expansion and the poor heat conduction. Strippers of tempered steel, machined by electric erosion methods with exact fitting to the die, are also used. Roller guides are used, along with ball types. The guiding of the band in these stamps is achieved by guide slats, reinforced with hard alloy cross keys or guide rods and rollers, which diminish the friction of the band, and strippers which lift the band and lessen its friction against the face of the die. These elements are made of hard alloy.

As the elastic elements in these stamps, it is recommended to use plate and spiral cylindrical springs. Polyurethane is not suitable[1,2]. The gaps between the die and the punch in the stamps for high-speeed presswork are taken to be 12-20 percent of the thickness of the stamped material[3]. The bilateral clearances according to experimental data for high-speed pressing stamps (n = 400-800 strokes per minute) are presented in Table 1. As experience shows, a 20-30 percent reduction in the clearances reduces the stamp durability by as much as 50 percent.

Table 1. Bilateral Clearances in Cutout of Metal Materials on High-speed Presses (n = 400-800 stroke/min)

Thickness of material, mm	Low-carbon steels 10 and 20, copper, brass, aluminum		Medium-carbon steel 45, Dural, bronze		High-carbon and electric engineering steel	
	Minimum clearance	Allowable deviation	Minimum clearance	Allowable deviation	Minimum clearance	Allowable deviation
0.1	0.015	+ 0.005	0.015	+ 0.005	0.015	+ 0.005
0.2	0.025		0.030		0.030	
0.3	0.030	+ 0.010	0.045	+ 0.010	0.050	+ 0.010
0.5	0.050		0.060		0.065	
0.6	0.065		0.070		0.075	
0.7	0.070		0.080		0.090	
0.8	0.080	+ 0.020	0.090	+ 0.020	0.110	+ 0.020

Table 1. Bilateral Clearances in Cutout of Metal Materials on High-speed Presses (n = 400-800 stroke/min)

Thickness of material, mm	Low-carbon steels 10 and 20, copper, brass, aluminum		Medium-carbon steel 45, Dural, bronze		High-carbon and electric engineering steel	
	Minimum clearance	Allowable deviation	Minimum clearance	Allowable deviation	Minimum clearance	Allowable deviation
0.9	0.095		0.100		0.120	
1.0	0.100		0.110		0.140	
1.2	0.125		0.140		0.180	
1.5	0.160	+ 0.030	0.180	+ 0.030	0.220	+ 0.030
1.8	0.180		0.210		0.270	
2.0	0.200		0.230		0.290	
2.2	0.230		0.270		0.300	
2.5	0.270	+ 0.050	0.300	+ 0.050	0.360	+ 0.050
2.8	0 300		0.330		0.410	
3.0	0.330		0.380		0.450	

A substantial impact is achieved by using nonblock stamps in high-speed presses for small and medium series production. Thus, with a program of 10,000 parts, fabrication on a crank press takes 3 h, including the adjustment, while a high-speed press (n = 500 strokes/min) requires 30 min. The main requirements for high-speed pressing stamps and the structural features assuring these requirements are presented in Table 2.

Table 2. Requirements on High-Speed Pressing Stamps and Structural Elements Achieving These Requirements

	Elements	
Requirements on high-speed pressing stamps	Multiposition block stamps for presses of type AB6224, PASZ 63.3, etc., with 400-1000 kN	Nonblock stamps for presses of type PA-10, SN-138, etc., with 100-250 kN
Increased stiffness	Increased thickness and hardness of plates. Block columns larger in diameter than traditional stamps	Punches of reduced length (to 32 mm) with 40-50 percent of their length secured in the punch holder
High stability and accuracy of movement of upper section of stamp compared to lower	Ball-bearing guideways with 1.5-2 fold increase in number of balls compared to guideways as per GOST 14678-83; roller-bearing and special guideways. Movable stripper with its own antifriction guideways (no less than 4)	Antifriction guideways with balls of 2 mm diameter (usually 4)
Minimum friction of punches against stripper	Guideways in windows of stripper reinforced with cast iron or bronze inserts; stripper of tempered steel; side clearance of windows in stripper (no less than 0.1 per side)	Stripper is not a guide for the punches. At height of 2-3 mm, gap between punch and stripper 0.05-0.1 mm, elsewhere stripper is clear
Increased wear resistance of working elements	Working elements of alloyed tool steel or hard alloy	Working elements of hard alloy or alloyed tool steel. If production lot small, working elements of steel U8.
Accurate step feeding of material	Spring-loaded outlying catchers (no less than 2). Outlying catchers linked to an interlock, shutting off the press	Precision roller press feed
Reliable guiding of band in the stamp, reduced friction of band against die face	Guide rods (usually hard alloy) or guide rollers, strippers lifting the band above the die in the form of rods or swiveling balls	Guideways in the form of a continuous slot in a tempered plate (guide stripper), roughness Ra 0.62 mcm
Smaller moving masses and lateral vibrations	Upper plate and movable stripper of reduced mass. Movable element fastening stamp to press or a special inertial-damping design	Moving element fastening stamp to press

No possibility of scrap being lifted behind punch	Channels in punches for passage of compressed air or recesses at working end face of punch, or spring-loaded strippers in punches	Working windows of die and windows for punches have high roughness (Ra 2.5-1.25 mcm)
Possibility of continual lubrication of punches, guideways, and material being stamped	Oil-filled recess in stripper. Lubricant should be supplied to guideways of stamp, and there should be a band lubricating and cleaning device; interlock preventing a jammed band (weld or double ply) from getting into stamp	Press has oil guides supplying lubricant to certain points of stamp and to material being stamped
Uniform clearances between die and /punches	Dies and punches made with more rigorous tolerances (0.002 mm) or made by automated electric technology methods	Punches and guides made by automated electric technology methods

Use of the structural requirements on the tooling of high speed automatic presses enables more effective utilization of modern pressing equipment and better labor productivity in sheet stamping.The economic impact from adoption of nonblock unified stamps for the high speed automatic machines of the Special Relay and Automation Design Bureau at the enterprises of the Ministry of the Electroteochnical Industry alone amounted to roughly 1 million rubles per year, taking into account the industrial output of these at the Kolomyya Electroosnastka Plant.

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Unification of Gantry Cranes

18610007 Moscow STANDARTY I KACHESTVO in Russian1No 6, Jun 88 pp 12-14

[Article under the "Standards and Technical Progress: Development of Unification Projects" rubric by A. A. Kovin, I. S. Mazover and B. I. Plavnik of the Leningrad S. M. Kirov Hoisting and Transport Equipment Plant]

[Text] Gantry cranes are one of the most effective means of mechanization of loading and unloading work. Depending on the work being done, we distinguish two types: loading and assembly cranes. The former are intended to work with mass bulk loads (sand, coal, ore, etc.), using a bucket, or with single loads at sea and river ports, industrial depots, and elsewhere, using a hook suspension. The second are designed for assembly and installation work, primarily at ship building and ship installation factories, as well as other sectors of the economy.During the process of design of series manufactured gantry cranes, the factory designers have accomplished much work on unification of all crane models, assembly units and parts. In particular, a unification procedure has been worked out to afford the most comprehensive and, at the same time, ecnomically feasible unification of all crane models, assembly units, and parts.

We should emphasize that such unification is made possible only by conceptual design of all crane models at the same time. Figure 1 shows a diagram of a gantry crane and its movements, which may occur in any given combination at the same time.

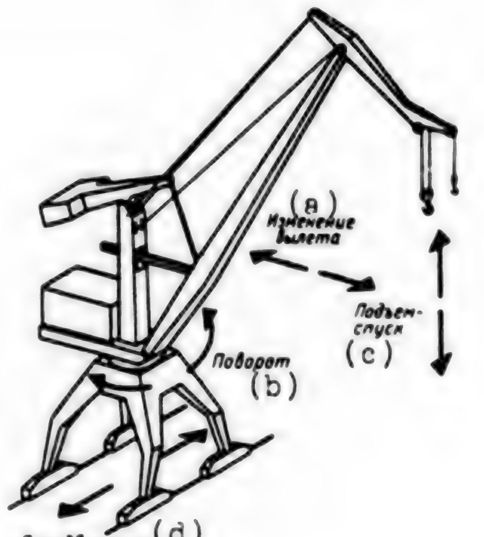


Figure 1. Diagram of Motions of a Gantry Crane
Key: a. Change in reach; b. Turning; c. Lifting/lowering; d. Dispiacement

The following basic parameters in particular have been standardized in the design of series gantry cranes: the largest and smallest reach, the lifting height, the rear clearance, the track gage, and the base. This unification created the necessary foundation for unification of the metal structures. In design of the metal structures of gantry cranes (the gantries, frameworks, booms, etc.) and their parts, a method of unification by outer geometrical parameters worked out at the factory was taken as the

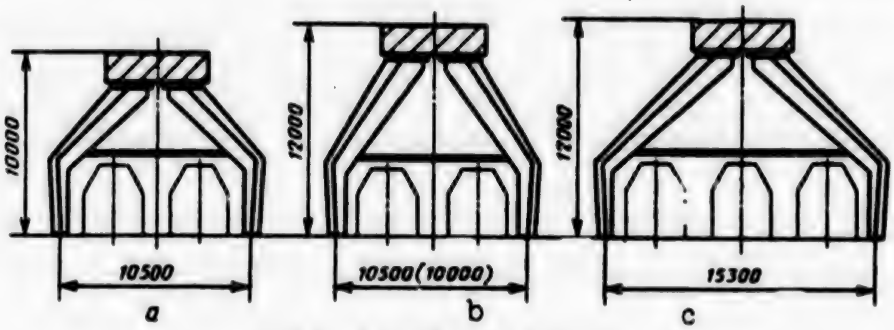


Figure 2. Unification of Gantries

Key: a. Gantry of a two-track loading crane; b. Gantry of a two-track assembly crane; c. Gantry of a three-track loading crane

foundation. The essence of this consists in taking all external geometrical parameters (as well as the connecting flange-elements or hinges) for metal structures of cranes of different lifting capacity as identical, but the thickness of the plates as differing.

Thus, in the case of the booms of cranes KPM 20/10, the entire top part is made of plate with thickness 6 mm. For the booms of cranes KPM 32/16, while observing the same outer dimensions in the top part, the plates are 6, 8, 10 mm. In the event that it is not possible to make full use of an entire assembly unit for different crane models, the individual parts are used. A characteristic example are the gantries, which differ in track gage and height (Fig. 2). In all these gantries, the head pieces are identical, while different gage and height are obtained by different dimensions of the legs.

Implementation of the above-described unification also increased the size of the production run of assembly units and parts. This, in turn, made it economically feasible to construct special rigs for assembly and welding of the booms, the legs of the gantries, the brackets of the frameworks and other metal structures. Despite the high cost of these rigs, the investment was quickly repaid by an average of 20 percent reduction in labor intensity of the fabricated subunits, at the same time achieving high quality and interchangeability. Three unification versions for the mechanisms have been developed in the design of a unified series of gantry cranes.

First version. The identical mechanisms are used in the different cranes, but in different amounts. Thus, identical drive and idle two-wheel trucks (Fig. 3) are adopted in the motion mechanisms of all gantry cranes with lift capacity of 3-80 tons, but in different quantities.

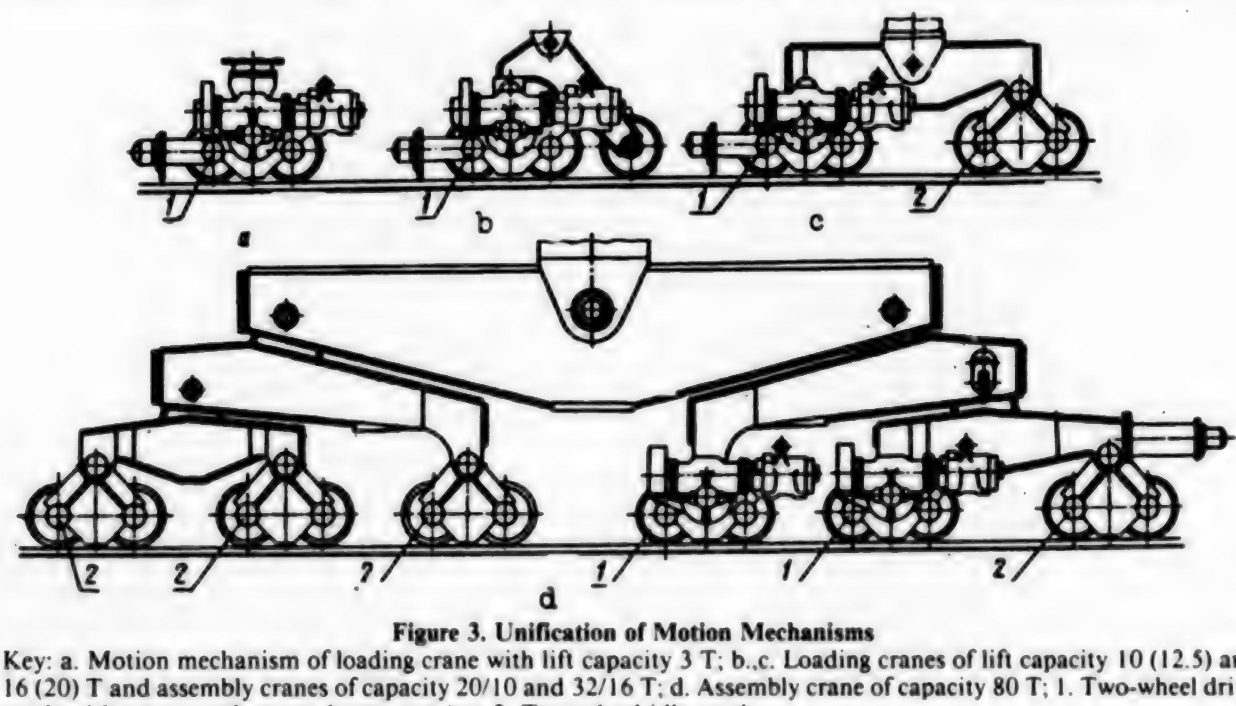


Figure 3. Unification of Motion Mechanisms

Key: a. Motion mechanism of loading crane with lift capacity 3 T; b.,c. Loading cranes of lift capacity 10 (12.5) and 16 (20) T and assembly cranes of capacity 20/10 and 32/16 T; d. Assembly crane of capacity 80 T; 1. Two-wheel drive truck with motor, reducer and open gearing; 2. Two-wheel idle truck

As a result, despite the considerable difference both in terms of crane mass (75-500 tons) and pressure of the gantry legs on the rails (38-275 tons), the pressure of the running wheel on the rail (being the primary designed load for the motion mechanism) is more or less identical for all cranes. This made it possible to use the identical running wheels, truck frames, worm reducers, open gear trains, electric motors, brakes, and other elements for all the cranes. The number of identical parts increased so much that it became possible to organize the manufacture of several of them in special flow lines.

Second version. The identical mechanisms are used in different cranes, but several parts are different in them. Thus, the lifting mechanisms of cranes KPM 20/10 and KPM 31/16 are basically identical and differ only in the cables, the grooving of the drums, and the blocks. The turning mechanisms of these cranes differ only in the motors, the mechanisms for changing the reach (motors), and the configuration of the reducer (transmission ratio).

Third version. Different cranes employ identical assembly units in the second and successive stages, and identical parts. Thus, without unification, it was necessary to have 29 reducers for all assembly cranes; with unification, only 13 are needed. The same applies to the brakes (only 12 instead of 28), the couplings (11 instead of 23), and so on.

Thanks to unification of assembly units, it has been possible to achieve an extensive unification of the various crane models (cf. table). The factor of unification between designs has been increased to 74 percent.

Unification of Different Models of Series Gantry Cranes

Name of crane		Metal structures: Gantry	Platform	Framework	Boom	Yoke	Balance beam	Mechanisms: Main lift	Auxiliary lift	Turn	Reach	Displacement	Supporting and turning structure	Cabins: Driver	Control
KPP	10 (12.5)	I	I	I	I	I	I	I	-	I	I	I	I	I	I
	16 (20)	I*	I*	I*	I*	I*	I*	I**	-	I	I	I	I	I	I
KPM	20/10	I	I	I	I	I	I	II	I	I**	I**	I	I	I	I
	32/16	I*	I*	I*	I*	I*	I*	II**	I	I**	I**	I	I	I	I
Number of standard dimensions of assembly units		1	1	1	1	1	1	2	1	1	1	1	1	1	1
Total of assembly units	With unification								15						
	Without unification								54						

KPP - loading gantry crane; 10 (12.5) and 16 (20): first number indicates lift capacity (T) when using a bucket, second figure (in parentheses), using a hook; KPM - assembly gantry crane; 20/10 and 32/16: first number (numerator) indicates maximum lift capacity, second (denominator) lift capacity at largest reach.

Note: Identical subunits are designated by identical Roman numerals; * - identical outer dimensions, differing in wall thickness; ** - mechanisms differing in motors, cables, drum grooving, blocks, and transmission ratios of reducers.

The cumulative economic impact from the unification in the design of series gantry cranes and the manufacture of the cranes and their accessories is around 3 million rubles per annual factory program.

UDC 621.9.06-133:658.527.011.56

Automatic Rotary Machine for Fastener Assembly

18610406a Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 88 pp 1-2

[Article by Engineers A.I. Kotenev and B.B. Krupin under the rubric "Automation of Production Processes"]

[Text] At many enterprises in various industries, fasteners (a screw and a washer) must be assembled prior to being delivered to assembly operations, in order to reduce unproductive time.

There are various types of devices that mechanize fastener assembly, although in some places manual labor is still used as well.

In order to automate the process and increase labor productivity, the Smolensk Refrigerator Manufacturing Plant developed and implemented an automatic rotary machine for fastener assembly (RFA). The machine has an original design, characterized by simplicity, absence of transfer arms, reliable operation and high production rate. Use of the V-55 elastic insert simplified clamping of assembled units.

The RFA design is as follows (Figure 1). Rotor 2, vibrating bin feeders (M4 x 50 screw feeder 3 and washer feeder 4) and trough-type strippers (5 for removing assembled units and 6 for disposing of rejected parts to a special container) are installed on table 1. In the lower portion of the table, electric motor 7 (Figure 2) is installed. Rotation from the motor to the rotor is transmitted via helical gear drive 6. In this particular case, an RD-09 motor is used. It has a variable ratio, which makes it possible to achieve any given throughput.

The RFA operates as follows (see Figure 2). Parts are loaded into hoppers of vibrating bin feeders, where they get oriented and arrive via a trough to loading positions of the upper 1 and lower 2 sections of the eight-position rotor. When the rotor turns, rod 3 with a washer is extended by cam 4, the washer is placed on a screw and held in place by elastic magnetic insert 5 in the upper part of the rotor. As the rotor keeps turning, the rod retracts downwards, and the trough-type stripper places the assembled unit into a container.

The other stripper 6 strips reject washers (those with a displaced or missing hole) from off the elastic magnetic insert and places them into a special container. The reject washer will push the screw that was supposed to be mated with it until the screw touches elastic magnetic insert 8 and is held in place, then the screw is jettisoned back into the bin hopper (not shown).

The above described RFA is used for dedicated types and sizes of parts, but when needed, it can used for assembling parts with different dimensions, if the operating rotor is changed.

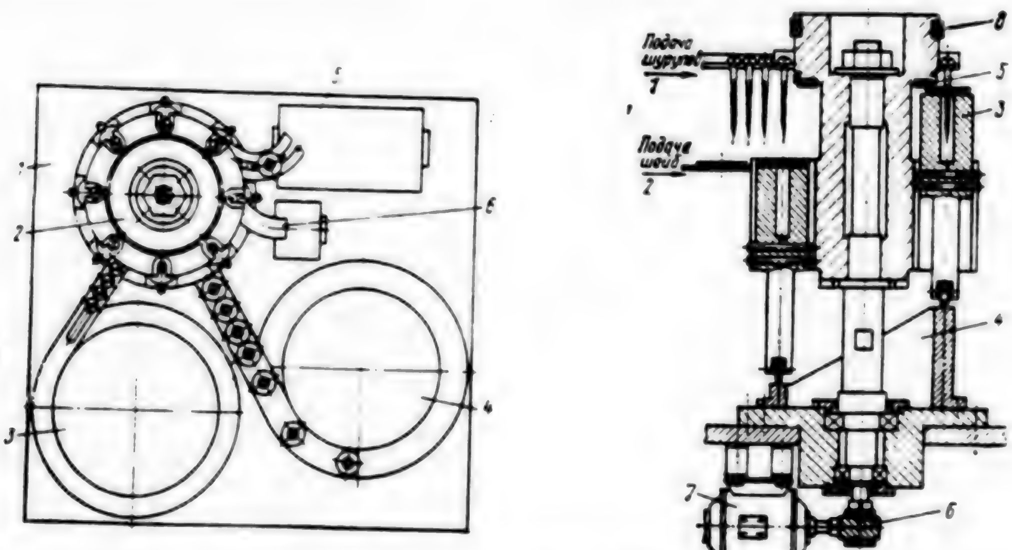


Figure 1 (left). Automatic Rotary Assembly Machine. Figure 2 (right). Rotor Corss-section

Key: 1. Screw Feed, 2. Washer Feed

Technical specifications

Prduction rate, thousands pieces per hour	7-8
Installed capacity, kW	0.6
Overall dimensions, mm	500 x 500 x 900
Mass, kg, does not exceed	50

Implementation of the RFA has increased labor productivity, reduced production area and freed up two workers.

UDC 681.3.06:655.4/.5

Restructuring of the Information Fund—An Imperative of the Modern Day
18610010c Moscow VESTNIK MASHINOSTROYENIYA in Russian No 7, Jul 88 pp 71-74

[Unattributed article]

[Text] The strategy of accelerating the socioeconomic development of the nation presupposes an intensification of development of the economy and, especially, its cornerstone of machine construction. Hence, 63 billion rubles have been set aside for modernization and development of the machine industry in the 12th Five Year Period and production is to be boosted by a factor of 1.7, more than that of industry as a whole. The present task is drastic increase in the technical level of machine products: by the end of the 12th Five Year Period, the proportion of the most important types of series manufactured items corresponding to the worldwide technical level should attain 80-95 percent. Attainment of the worldwide technical level for a given item is viewed as the minimal goal, while the primary goal is to surpass this level.

Successful solving of the range of problems confronting the machine industry requires utilization of all available capabilities, including publication of more current and efficacious scientific-technical literature. This dictates the necessity for restructuring and modernization of the publishing world, including the Mashinostroyeniye publishing house. The main goal of the publishing house is prompt and complete satisfaction of the needs of the machine manufacturing industry for scientific-technical literature of high content quality. What are the primary areas of activity of the members of the publishing house in reaching this goal, the possible obstacles and ways of overcoming them?

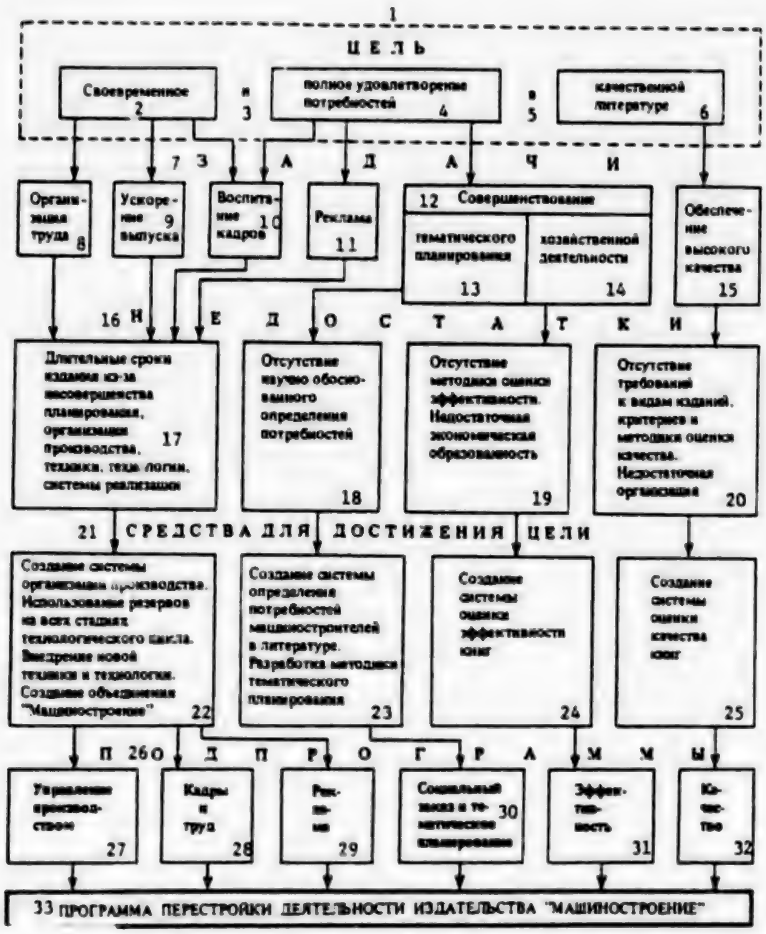
The answers to these questions may be found by using one of the modern methods of management—the method of the systems approach to solving a problem. Use of this method allowed us to determine the main directions (diagram) of radical restructuring, as well as updating of methods and management style in publishing. These directions are as follows: 1. Ascertaining the requirements of mechanical engineering specialists for scientific-technical literature and use of the findings in the planning of subjects. 2. Better content quality of publications. 3. Optimal organization of work in all sectors of the publishing process. 4. Improved economic mechanism, better working effectiveness of publishing. 5. Accelerated output of scientific-technical literature, viewed as a means of introducing the achievements of science into production, dissemination of progressive experience of the enterprises and work forces. 6. Improved personnel policy. 7. Improved advertising.

Along these lines, a program of radical restructuring of the activity of the Mashinostroyeniye publishing house has been worked out, including six subprograms: "The Social Contract and Subject Planning," "Production Management," "Quality," "Effectiveness," "Staff and Labor," and "Advertising." The specifics of each are reflected in the title, and therefore we shall not discuss them in detail. We merely dwell on the first subprogram "The Social Contract and Subject Planning," since this is the link mediating the contact between publishing and mechanical engineering. Thus, the most important stage in this subprogram is determining the requirements for various kinds of scientific-technical literature and using the findings in the subject planning. This phase has proved to be the most time-consuming and (most important) mentally taxing, since many are accustomed to letting matters plod along, while a system requires constant attention and effort. The initial organizational difficulties are being overcome, however, and work has already begun in this area. Analysis of the output of scientific-technical literature, the numerous readership conferences held in recent time, the letters from specialists received by the publishing house, and questionnaires filled in by mechanical engineers have pointed out many deficiencies in the work of the publishing house.

Thus, we still publish too few books for workers, especially in welding. The industrial books contain a lot of formulas, which are at times criticized by the specialists. Often the books provide outmoded, or even irrelevant material. Examples of such deficiencies could be multiplied. The existing subject planning procedure suffers from one major drawback: lack of a system. No single specialist or organization, albeit highly qualified, is able to indicate clearly and unequivocally which subjects are not encompassed by the plan and which may be included in it at the given time, lacking a systems approach. This is particularly difficult to do in the case of the plan of a specific year. It is obvious that the method of meeting requirements should only be determined after the requirements are identified.

Therefore, from the scientific perspective (or even the practical), we have divided the present subject planning into three phases: determination of the social contract on the basis of a systems approach (construction of the social contract matrix), the social contract process itself (commissioning of manuscripts in subjects based on the resulting matrix), and scientifically grounded subject planning (with the manuscripts or agreements prepared on the basis of the social contract).

The most difficult task is competent construction of the social contract matrix, making use of a "tree of functions" or a "tree of goals." At present, the Mashinostroyeniye publishing house has developed a matrix which includes systematized and elaborated themes, proposed by the mechanical engineering organizations. The matrix helps determine not only the quantitative requirements of the specialists for scientific) technical literature (volume, circulation), but also (and especially important)



Key: 1. Goal; 2. Timely; 3. and; 4. Complete satisfaction of the needs; 5. for; 6. Quality literature; 7. Tasks; 8. Organization of the work; 9. Faster production; 10. Staff training; 11. Advertising; 12. Improvement; 13. In subject planning; 14. In management activity; 15. Assurance of high quality; 16. Shortcomings; 17. Lengthy publication time frames due to inadequacies in planning, production organization, equipment, technology, marketing system; 18. Lack of scientifically grounded determination of needs; 19. Lack of an effectiveness evaluation procedure. Inadequate economic education; 20. Lack of requirements on the kinds of publications, quality evaluation criteria and procedures. Inadequate organization; 21. Means of achieving the goal; 22. Creation of a system of production organization. Utilization of reserves in all phases of the technological cycle. Introduction of new equipment and technologies. Creation of a Mashinostroyeniye association; 23. Creation of a system to determine the needs of mechanical engineers for the literature. Development of a subject planning procedure; 24. Creation of a system of evaluation of effectiveness of books; 25. Creation of a system of evaluation of quality of books; 26. Subprograms; 27. Production control; 28. Staff and labor; 29. Advertising; 30. Social contract and subject planning; 31. Effectiveness; 32. Quality; 33. Program for restructuring the activity of the Mashinostroyrniye publishing house.

the subject requirements. Several words about the matrix. It is the foundation of the initial publishing work involving creation of an automated subject planning system using the personal computer. The matrix is a table in which the heading gives all subject areas presented in questionnaire 1. In the left-hand column, the types of scientific-literature are indicated (textbooks for technical schools, technical colleges, the common trades, industrial publications for engineers, technicians and workers, manuals for engineers, technicians and workers, scientific and popular science literature). The compartments of the matrix contain the index codes of all manuscripts and author submissions arriving at the publishing house, as well as the index codes of all books published in the current five year period. Author proposals of similar subject, assembled in the same compartment of the matrix, are easily analyzed, detecting redundancy, absence of manuscripts and proposals on certain topics, and oversaturation of other topics. In other words, the matrix is a trustworthy tool for selection of subjects for new book publications in the work of the publishing house. But this requires a clearcut determination of the priorities of the subject areas, and a quantitative assessment of their importance in the operation of

the mechanical engineering complex. In accordance with these priorities, we also propose a refinement of the structure of the subject plan of publication of scientific-technical literature.In view of the above, we request our readers to fill in the questionnaire 1 (subject areas), i.e., provide a percentage evaluation of the subject areas and their corresponding significance (in your opinion) in solving the problems of the mechanical engineering complex. The transition to total cost accounting obliges us to look for ways of saving resources where possible, especially ways of effective operation of all subdivisions. And the selection of book topics has paramount importance here. The problem is as follows: first, given our limited material and financial resources, to satisfy as much as possible the needs of the machine industry for scientific-technical literature, and second, to earn the means to cover all expenses and derive a profit. And the effectiveness of publications will depend on the type of literature and the circulation: the larger the circulation, the more effective the publication. For example, the publishing house begins to obtain a profit from industrial publications when the circulation is more than 15,000 copies. For a smaller circulation, the publishing house suffers a loss. Because of the lengthy time frame in production of scientific-technical literature, the work on the subject plan of production of literature for 1988 is already nearly completed, the plan for 1989 has been compiled and Soyuzkniga is already receiving orders for its publications. The first draft of the subject plan for 1990 has also been compiled. In other words, the work on the topics for publishing of the current 5-year period is practically finished. In the near future, compilation of the subject plan for production of literature in 1991-1996 will begin. The most important topics of future publications for the workers have already been determined. These are taken from the worker's unified handbook of rates and qualifications (YeTKS). Several topics of industrial publications for engineers and technicians have been outlined with the help of experts in the most important subject areas. These have been drawn up into a list. Democratization of the editing and publishing activity is one of the most important trends of the present day which, in our opinion, will make it possible to exclude a subject planning that is cloistered from the needs of the day and to select groups of authors from industrial workers capable of solving the stated problems on a high level of professionalism.

UDC 658.5.011.2:006.063

Roles of Perestroyka, State Acceptance Assessed

Gospriyemka: Where Next?

18610018 Moscow STANDARTY I KACHESTVO in Russian No 7, Jul 88 pp 67-68

[Article under the rubric "Gospriyemka and Gosnadzor" by A. B. Dragan, special correspondent of STANDARTY I KCHESTVO]

[Text] G. L. Davydov, director of the state inspection of the Moscow Krasnyy proletariy Machine Tool Plant, has often said in regard to the state inspection and the results of more than a year of work with it: "In the first phase of our work, we have only skimmed the surface, and it is now necessary to go deeper."

What do these words imply? Davydov spelled it out clearly, with concrete examples referring to the factory, in conversations with the most diverse of persons. After all, even for him the range of activity of the state inspection is a constant quest, in which broad discussion and conflict of the most diverse and often contradictory points of view are essential.

The plant was founded in 1857. We have three production lines: a large series production of NC machine tools; a series production of two modifications of semiautomatic spindle lathes; a production of special machine tools and robots at the Cheremushki subsidiary.In terms of organization, the members of the state inspection (66 in all) are divided into four groups. One of these is in the subsidiary at Cheremushki. The other three are at the main site: one group is involved in inspection of the parts made at the factory shops, a second inspects the finished product, checks out the lathes, the packaging and the labeling, while the third inspects the semiautomatic vertical lathe. Some members are assigned to incoming inspection of complementary parts.

On our way to the machine shop where the factory tour was to begin, Davydov mentioned that the activity of the state inspection has reduced the number of complaints, and the time to set up each machine by the customer has been reduced 25 percent, producing an overall gain of 3 million rubles for the economy. The requirements on the suppliers are also more rigorous—last year, five times as many penalties were levied as in the previous term. At present, there is virtually no possibility of defective parts being supplied for the machines. However, the director of the service sees the main achievement in a different area: "Today, it is not usually necessary to take the worker by the hand. The workers, responding to the introduction of the state inspection much more quickly than the engineers and technicians, have become more demanding not only of themselves, but also of all the engineering departments, especially the designers and process engineers."

To confirm and explain these remarks, Davydov took me to a work station where several people were scraping parts by hand. What happened here? They were machining a carriage, but the roughness was above the norm. The planarity did not meet the demands of the state standard. It would not pass the technical inspection division or the state inspection. The workers went to the process engineers, and then the designers. They analyzed the situation. It turned out that the process engineer made a mistake, calling for the wrong tooling. The machine formerly producing better precision could not be used now. Why? Because the length of the carriage had been changed by no more than 100 mm; and because this portion by which the carriage had been increased was less abraded, a ledge was formed, causing the defect. Thus, it turned out that the engineer was at fault, but the worker suffered for it. "It is the worker who is affected by all shortcomings of the engineering departments," continued Davydov. "We have asked much of the workers,

placing them in very difficult conditions, and they have responded to this with understanding and the right spirit, though not always effortlessly. As a result, the workers today do not turn out defective parts, but try to correct the problem themselves, or ask the process engineers and designers to clarify and eliminate the causes of defects." Judging from the results, the workers are increasingly regarding the state inspection as their ally, which can and must protect them against the confusion and disarray of the engineering departments. But for this, the state inspection should expand its activities to the preproduction phases of creation of products and appropriately influence the quality of work of the designers and process engineers.

It will be appropriate here to mention the viewpoint of the first assistant director of the executive office of the state product inspection of the USSR State Standard, B. P. Chumakov: "In the new phase, the activity of the state inspection should not be confined to the enterprise or association, but should extend to all stages and phases of the product life cycle. In representing the interests of the state as customer, the state inspection should oversee the formation of quality of future products, starting with development of the request for proposal of their design, coordinating all the primary documentation resulting from the respective phases of research and development, participating in the solving of problems pertaining to preparation and startup of production of the articles, maintaining close contacts with the organizations and enterprises within its purview that will use the products, and much else." (cf. STANDARTY I KACHESTVO, No 8, 1987, p. 15)

The design engineers take a different view of this problem. "No, there is no need to introduce the state inspection in design," declares the assistant chief designer of the plant, M. S. Shuster. "In our creative process, an outside party will only mess things up. As for design flaws they are perfectly natural: you can't predict everything in advance."

Let us interrupt our interview for the time being and look in on one of the shops, at the new facilities. There is some kind of diagram on a scrap of paper in front of a worker. Evidently, he is using this to put together the electrical circuit of a machine. "You see," explains Davydov, "this diagram of machine 8941 was made by the worker himself, not a designer." Why? "Because the design developed by the designers doesn't work," explains the worker. "I put it together as directed, but the machine would not run. I had to modify it, at my own responsibility. It would be good for the designers to come here more often and make sense of their inventions."

"It is still very hard to deal with the designers," comments S. Grigoryev of the state inspection, joining us. "When you tell them it is necessary to make changes in the blueprints, they usually stiffen their backs. It is a matter of pride of invention." The more you come to learn of operations at the plant, the more you are convinced that the tradesmen—fitters, electricians, welders—are much more receptive to the changes. Strangely enough, those in the creative departments are resisting. At the same time, it is a known fact that the discovery and correction of flaws in the design process is cheaper by an oder of magnitude than that during the manufacture. But in order to achieve this impressive savings, one of two things is necessary: either the designers should touch up their blueprints directly in the production shops, or these blueprints should go through state inspection before coming to the shops.

"Obviously, design work without paying due regard to the specific production environment, working 'by eye', rough sketches, and infinite penciled-in corrections result in inaccuracies, so that the products will have to be worked over many times," continues Grigoryev. "And it is the worker who is most vitally concerned with immediate resolution of the problem of better quality of work of the designer and process engineer. This concern is not only ethical, but also financial. But the engineering departments are not at all affected."

In the opinion of Davydov, there is only one solution to the dilemma: to extend the activity of the state inspection to the product creation phases. This would substantially improve not only the product quality, but also the production effectiveness.

In conclusion, we should mention that despite our conversation concerning the need to overcome one deficiency, the situation at the enterprise is by no means critical. Krasnyy proletariy is a leader in lathe production, one of the first to master the difficult process of elevating the quality of our products to the international standard. The conversion to complete cost accounting, the radical reconstruction which has started, the second wind which the state inspection has received, give reason to expect that all difficulties will be quickly and successfully overcome

UDC 65.011.56:658.5:006.065

Perestroyka in the Eyes of the General Designer
18610018 Moscow STANDARTY I KACHESTVO in Russian No 7, Jul 88 pp 5-11, 24

[Continuation of article under the "Quality — A Factor of Progress" rubric by L. N. Alperin, special correspondent of STANDARTY I KACHESTVO; beginning of interview in STANDARTY I KACHESTVO, No 6, 1988]

[Text] An interview with N. V. Filin, general designer of cryogenic equipment and first assistant on research matters to the general director of the Scientific Production Association Kriogenmash.

Correspondent: At the beginning of our interview, you said that one of the main tasks of assuring competitiveness of Soviet cryogenic equipment is for the association

to have a rate of development no less than that of the Western companies producing similar products. As I understand you, this task is being handled rather well by the existing mechanism of continuous product quality control at the association. However, the rate of development depends in large measure on the technical underpinning of research, design and production, and on automated supervision of each of these three elements in the new product development cycle. Could you talk about what is being done in this latter area?

N. V. Filin: Intensification of production in the machine industry, whose results are both an appearance of new machine generations and an increased volume of manufacture, involves more complicated and labor-intense supervision of the product development cycle, since the flow of information is drastically increased. Traditionally, this has involved a more strenuous and longer work day for the personnel of the respective subdivisions. The end result is usually an increase in the work force. But this does not solve the problem, since new difficulties arise from the need to coordinate the decisions being made by the ever increasing number of people. Nevertheless, the flow of information continues to expand, and sooner or later it surpasses the capabilities of the executive personnel. And this leads to the danger of making flawed or untimely decisions, an increasing number and seriousness of omissions, unfinished work, reduced efficiency and effectiveness of the supervision, a drop in effectiveness of production, and worsening product quality.

There is only one way to eliminate these difficulties: creation and use of the appropriate automated management systems. And we are following this course, developing and modernizing an integrated automated management system (IASU), which presently includes an automated system of scientific experiments and testing (ASNESI), a CAD system for cryogenic products (products-CAD), a CAD system for process documentation (technology-CAD), and an automated management system for production and scientific activity (ASUP). Each of these, in turn, consists of a corresponding array of subsystems. The composition, components, and importance of these vary over the course of development and modernization of each automated system and the IASU as a whole. Thus, the products-CAD presently includes the subsystems: installation-CAD, system-CAD, device-CAD, machine-CAD, strength-CAD, thermal physics-CAD, design-CAD. An idea as to the future appearance of this automated system can be gained from its prospective diagram.

I should mention that it is my deep conviction that the development and introduction, refinement and modernization of automated management systems is by no means a fashionable and expensive growth in the technocrats, but an objective necessity, dictated by certain mechanisms of scientific and technical progress. We are therefore doing our utmost to follow this course as quickly and as far as possible.

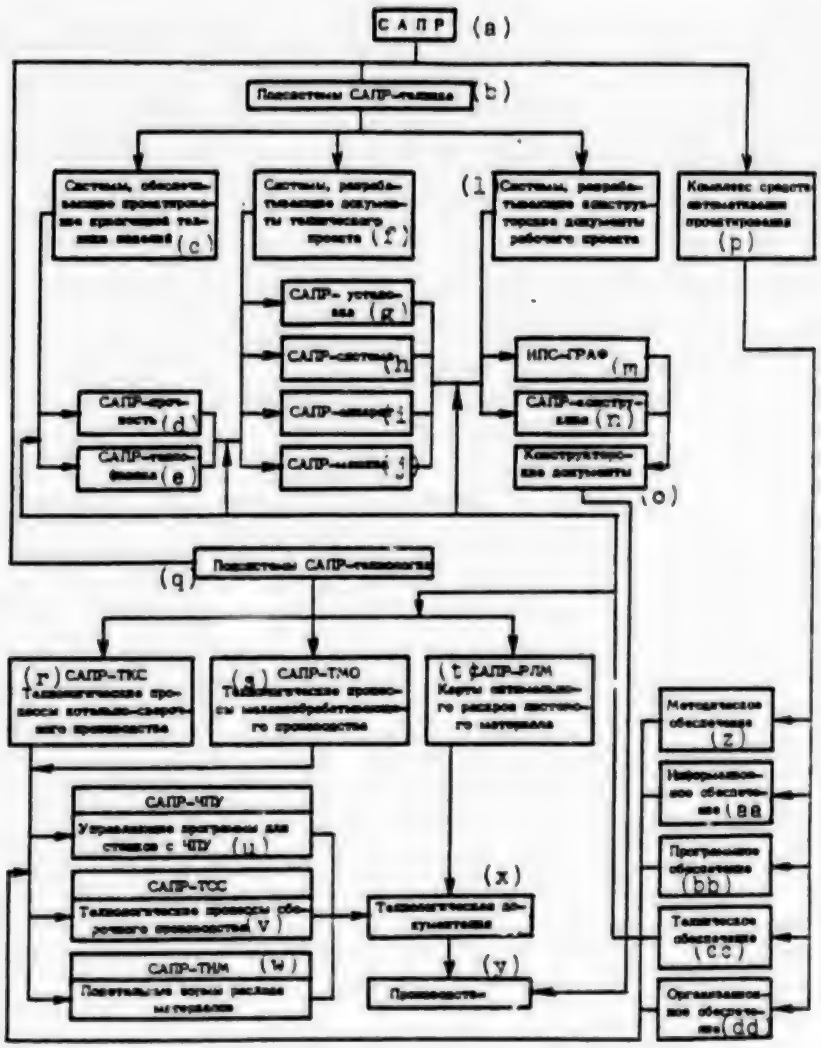
Correspondent: It is a known fact that one of the mandatory conditions for successful automation of production and management is a high level of standardization, especially standardization of parts and assembly units of products and typization of the technological processes of their manufacture. And since the automation policy has been adopted in earnest and over the long haul by your association, there is surely no need for your standardization personnel to worry about their future.

N. V. Filin: The prospects of our standardization workers are indeed good. However, I would like to point out that standardization is not the concern solely of the standardization staff. In our organization, at any rate, it is the concern of not only the members of the standardization division, but also the designers. It is their direct responsibility, and extremely important. Of course, they are helped by the members of the standardization division in working out the procedural and organizational problems. But the most important element of standardization and unification—what to do, how to do it, and what is to be achieved—is still the concern of the designers. That is how we have arranged things. As a result, nearly 30 percent of the work done by the designers involves unification and standardization.

This became possible by the many years of hard and dedicated work of the association on ever increasing unification of parts and assembly units, as well as typization of technological processes. According to the established procedure, the designer is authorized to develop a new part or assembly unit only if he can prove that the problem cannot be solved by using elements from the unification catalogs. And if it is found that he has violated this procedure during a particular phase of the product development, the blueprint of the part will be returned to him to do over. As a result, the mean annual renewal of parts and assembly units does not exceed 30 percent. This means that 70 percent of new products are assembled from previously developed parts and assembly units whose production is ongoing. A mean level of unification up to 90 percent has been achieved in some of the products. Thus, it is only necessary to develop 10 percent new parts and subunits in order to create a product essentially different from all those formerly produced. This is what has made possible our breakthrough in solving the problem of raising the technical level and quality of a number of our products, a reduction in the duration of their development cycle, and favorable conditions for computer-aided design of articles and technologies.

Correspondent: Could you explain just how unification affects the process of computer-aided design?

N. V. Filin: In order to create the groundwork for automation, unification alone is not enough. It is necessary to implement all components of the complex "classification/unification/typization/specialization/automation." This is especially important for our association, as any other machine building enterprise



Prospective Diagram of the CAD Layout

Key: a. CAD; b. Products-CAD subsystems; c. Systems supporting design of cryogenic engineering products; d. Strength-CAD; e. Thermal physics-CAD; f. Systems for development of engineering design documentation; g. Installation-CAD; h. System-CAD; i. Device-CAD; j. Machine-CAD; l. Systems for development of detail design documents; m. Graphics information retrieval system; n. Design-CAD; o. Design documents; p. Computer-aided design tools; q.Technology-CAD subsystems; r. CAD for technological processes of boiler-welding production; s. CAD for technological processes of machining; t. CAD for optimal sheet material cutout diagrams; u. CAD for NC machine control programs; v. CAD for technological processes of assembly work; w. CAD for material outlay norms by part; x. Technological documentation; y. Production; z. Procedures; aa. Database management; bb. Software; cc. Hardware; dd. Organization

with individual or small series manufacture of scientific-intensive, large-sized, and complicated products assembled from a large number of component parts of uniform type. For example, air separating layouts contain up to 10 or 12,000 standard dimensions of assembly units and parts. In such circumstances, even with powerful computers on hand, it is very hard to assure a high quality of preparation of the design and process documentation, or to efficiently handle the information flow regarding the course of production. The main difficulty comes not so much from the large volume and diversity of information, as from the lack of order, which leads to confusion, duplication, unjustifiably large labor intensity in preparation of the necessary decisions, and (most important) a high likelihood that these decisions will be faulty.

I should mention that, as far back as the early 1970s, when there was not even talk of computer-aided design, Kriogenmash was well aware that the main cause of

duplication in blueprints of parts and assembly units is the lack of easily available current information based on a well-designed system of designation of technical documents. Therefore, a project was undertaken to introduce a depersonalized system of designation of design documentation. Also at that time there began a successive unification of parts in terms of the following areas: unification and unitization of large-sized component parts of products, development of interspecific unification on the foundation of expanded use of standard assembly units and parts, development and application of unified assembly units, increased borrowing of assembly units from different types of equipment.

As a result of the work done on unification and careful design development of products and components, catalogs of unified series of devices, machines, piping, fixtures, assembly units and parts were created. This allowed us to organize a modular approach to the development of products, i.e., to implement the principle of unitization in reality, thus greatly cutting down on the timeframe and labor intensity of design projects.

In regard to the debate presently raging around adoption of GOST 2.201-80 and the YeSKD Classification System, I should like to point out that a depersonalized encoding system has a decisive advantage over a subjective system in terms of unification and automation. The assignment of designations to all constituent parts of products by previously developed and mandatorially-used classification systems prevents the possibility of different designations for parts or assembly units of identical type. This is especially important in a setting of a multiple product mix, characterized by high likelihood of duplication of designs for identical parts and subunits in development of different products. An important advantage of the depersonalized system of designation is that it enables a large-scale grouping of constituent parts of products, especially for purposes of unification. I should especially mention that the catalogs of unified series play the part of normative-technical documents that are incumbent on all development engineers at the association. I have already talked about how hard it is to enforce the principle that these documents are mandatory.

Correspondent: Do these catalogs provide the necessary underpinning for computer-aided design?

N. V. Filin: Yes, at machine manufacturing enterprises such as our own they play a critical role in creation of CAD. As a matter of fact, there are two different approaches to CAD, the end goal of which is to produce working design documentation, both text (specifications, calculation and explanatory notations, etc.) and graphics (working and assembly blueprints, general views, etc.).

In the first approach, CAD is created which is capable of working in interactive mode and solving the problems of optimization of alternative versions and use of computer graphics to synthesize new products or develop unique parts and assembly units. But computer modeling of all these tasks and procedures is a highly complicated and still little studied process. In the second approach, CAD is created with the primary task being not to develop new parts and subunits, but to choose quickly and accurately from among the previously developed parts presently in production or use. This choice is done from a databank, the foundation of which is the information (including graphics) in the catalogs of unified series of parts, assembly units, and products. Therefore, the higher the level of unification, the more efficient and effective such CAD.

Correspondent: CAD, then, is in fact a computer-aided information retrieval system?

N. V. Filin: CAD is much more complicated than this system, since it is required to solve a large array of problems during all phases of development of design documentation: formulation of the request for proposal, development of the engineering design and the detail design. Without doubt, the most arduous phase is the detail design documentation. Therefore, the central CAD subsystem is the graphics and text preparation of design documentation.

At our association, this subsystem should be based on an information retrieval system with databank containing information on assembly units and parts from the catalogs of unified series and industry standards. The language aids (thesauri) and key words (descriptors) of the information retrieval system are determined by the depersonalized system of design documentation designation. Today, when the level of unification of products of the association has reached 70-90 percent, it is clear that the products CAD enables computer-aided design of 70-90 percent of the unified parts and assembly units. The design of the 10-30 percent of original parts and subunits can be done, first, by the traditional method, second, by modifying already-existing unified designs of a part or subunit by use of display or traditional methods, third, by using a plotter, if the part is complicated and requires an optimization of parameters. As the products CAD becomes more sophisticated, the information retrieval system of the design documentation word processing and computer graphics subsystem should be supplemented with computer graphics application program packages (for design and drafting of original parts, assembly diagrams, transportation and installation diagrams, etc.) and interactive utilities for production of computation and explanatory comments on the document forms stipulated by the YeSKD standards.

To the foregoing, one should add that the catalogs of unified series of parts, subunits, and products also play a major part in reducing the time of technological preparation of production of new orders. As a matter of fact, in

the process of preparation of technological and production-plan documentation, the computer retrieves all necessary information from the databank. Therefore, the process engineers and economists will have to work out only the 10-30 percent of information not found in the databank.

Furthermore, the catalogs make it possible to devote serious attention to the production of optimal part production lots, to group the parts by design and process characteristics for loading of NC machine tools and robotic complexes, and to make more use of group machining methods.

For its part, unification, or the processing of elements and products in their entirety, composing them into catalogs, and assigning them the status of unified parts, is a long and time-consuming process, which can be done at present not only by traditional methods, but also using the computer. For this, information on the range of products and their constituent parts is transferred from the catalogs to machine media. The resulting databank contains numerical and text characteristics of the products and their component parts, as well as graphics information in the form of visual pictures of the parts and assembly units. The files of the databank also include information of technological and economic nature: whether a particular element appears in all assembly units, the material standards of the parts and the characteristics of the materials used, flow charts for manufacture of the parts and assembly units, the labor standards of the production steps, the professions and categories of worker, and so forth. Proper handling of the full array of information enables a more comprehensive and validated unification. Thus, the relation between unification and automation becomes bilateral. This is of major importance both to better product quality and increased effectiveness of production.

Correspondent: As I understand you, simultaneous betterment of product quality and production effectiveness has become possible first and foremost because extremely broad and far-reaching unification of parts and assembly units and typization of the technological processes of their manufacture at the association has enabled a truly mass production of component parts of unique products. Implementation of the policy of automation of production and control of the product development cycle, including the formation of products CAD and technology CAD, will doubtlessly increase the effectiveness of such production, while increasingly reducing the time and labor spent on design, preparation of production, and manufacture of new products.

Nevertheless, I would like an answer to one question: Will these products be sufficiently new to compete on the Western markets? Doesn't an increase in level of unification imply a reduced number of new and improved parts and assembly units? Doesn't such increase in the rate of growth of the association result in a reduced rate of growth of the technical level and quality of cryogenic equipment?

N. V. Filin: Each of our new products is able to compete on the world market. This is a tradition which we are not about to break. As for the proportion of improved components and the rate of increase in the technical level and quality of products manufactured by the association, these are certainly related to the level of unification of parts and assembly units, but not contingent upon it. Unification of a given subunit or assembly in no way implies that it is deprived of its possibility for change, or improvement, for all time. This possibility is retained and can be brought forth when needed. It all depends on being able to define the appearance of such need with sufficient exactitude. And this is what determines both the proportion of improved parts and assembly units and the rate of improvement in product quality.

I already discussed how firmly the association is adhering to its policy of ever increasing unification, at which time I pointed out that only those unified parts and assembly units with no demonstrable need for change are exempt from change. But if the proposals to change a particular subunit are comprehensively demonstrated and these arguments are convincing, the unified subunit will be modernized and become unique for a certain time, at expiration of which it again receives the status of a unified part. But this in no way implies that further development and modernization of this subunit will cease, or that it will be forgotten.

Implementation of the modular approach to development of new products, adopted by the association, actually means that each subunit and assembly evolves by its own logic and trend. The aim is to reach the limit of the potentialities. The decision whether to use the obtained results or to leave them as potentialities depends on many factors considered during the synthesis of the end product. Naturally, the main factor in this case is the predicted development of the best Western counterparts of the cryogenic equipment and the demand for it on the world market. And the specific nature of cryogenic equipment is such that the forecast is made by analyzing the development trends of the main components. Such element-by-element prognosis determines those unified assemblies and subunits which are to be modified, modernized, or improved.

One such critical element at present is the turbo-expander. We have already worked out a comprehensive program of development and improvement of such, which is being carried out. This entails both scientific research, experimental optimization of new design and technology decisions, creation of a specialized turbo-expander CAD, retooling of the respective production sectors, and much else. Everything has to be thought out, created, supplied, organized, utilized, set in motion, thus achieving the stated goal. If succes ul, our air separating

layouts using this assembly will be equal to or evenj-better than the world standard. Thus, the turbo-expander will no longer be a critical element for a certain time. Its place will be taken by a second element, and then a third, and so on. This is a continual process.

Correspondent: You have shown very convincingly how efficient and effective standardization can be in solving the internal problems of an enterprise. But there are also external problems that must be solved by means of standardization. Will you be able to solve these as successfully as the internal ones?

N. V. Filin: Unfortunately, no. This is due to many factors, but let me single out the two most important. First, is the clearly inadequate level of unification not only among sectors, but even within the sectors, which makes cooperation between specialized enterprises very difficult. But this ageold and well-known problem is due not to deficiencies of the standardization system, but to the imperfection of the economic structure. Therefore, it will apparently be solved by the perestroyka which has begun.

But the second factor is largely due to deficiencies of standardization itself. As production is increasingly attuned to the world marketplace, it becomes extremely important for a certain group of Soviet standards to comply with the analogous group of international and national standards of those countries with which we wish to trade. This compliance should cover both structure, and composition, and level of requirements. Failing this, it will simply be impossible for our products to reach the world market in any numbers. For no advanced capitalist country will purchase a product not complying with certain requirements of the international or its national standards, or if so, only at giveaway prices.

Correspondent: Could you make it clear which group of international and national Western standards you are talking about?

N. V. Filin: The group of standards regulating, first, the general and specific requirements on technical level and quality of product and testing thereof, in particular, the certification, as well as requirements on product parameters (and verification thereof) resulting from the need to assure safety and environmental protection; second, the principles, procedures and methods of determining all these requirements and assuring their implementation.

I should mention that all of this is regulated in our country. We have corresponding normative-technical documents, many of whose requirements are not below the Western ones. Thus, I do not think for a minute that our standardization or standards are worse. They are simply different: a different structure, a different set of indexes, and so on. There is no need to discuss the reasons for this difference. The main thing now is how to eliminate it as soon as possible, for this (in my opinion) is the primary and essential condition for successful solving of the problem of raising the quality of Soviet products to the worldwide level.

And just what is this worldwide level? It is not any quantity that can be computed by a formula, nor a list of indexes selected in accordance with an approved procedure. I am sure that efforts in this direction will be fruitless. It is necessary to study in earnest the process of formation of the set of demands which we call the worldwide level.

It has turned out that the requirements of the national standards of the technically advanced nations of the world over the course of many years have been drawing nearer to the requirements of the American standards which, in turn, incorporate all that is best, useful, and necessary, regardless of which country first established such in its national standards. As a result, optimal requirements on the product are formulated, compiled and codified for a certain length of time. The entirety of these requirements are what we call the worldwide level.

Of course, this is a very rough layout, a first approximation to the complicated actual process in which we must become involved, unless all our efforts at solving the problem of product quality and entrance to the worldwide market are to be fruitless. With perestroyka in full swing, this should be done quickly and vigorously, and there are various possible avenues: either the corresponding Western standards should be used as our national ones, or our standards should be brought into correspondence (in composition and level of requirements) with the international ones. In such case, compliance of Soviet product quality with the world level will be easily and clearly determined: whether or not all parameters of the evaluated product correspond to all requirements of the respective standards. Many apparently insurmountable difficulties of creating in our country a system of information on the latest achievements and development trends of corresponding areas of Soviet and Western science and technology will be effortlessly removed. This will result in better effectiveness and efficiency of the product quality certification system, facilitate the introduction of a product certification system on the Western model, encourage the development of a state product testing system, and so on. All of the difficulties in this area are secondary, I believe, compared to the difficulties of coordinating the Soviet and Western normative-technical documentation.

Correspondent: What do you think are the main reasons why these initial difficulties have not yet been overcome, even though (so far as I know) the USSR State Standard has been vigorously and persistently trying for many years to bring the Soviet normative-technical documents into conformity with the Western ones?

N. V. Filin: It is not a question of the State Standard, whether it is doing a good job, whether it is persistent or firm enough. The problem is not being solved, not

because they don't want to solve it or understand how important it is. It is easy to adopt at once the requirements of the Western standards in our national standards, but it is difficult to implement them. At any rate, it is not yet within the ability of our machine industry. The nation's industrial force is not yet ready, either technically, or technologically, or even organizationally. It is not ready because of the years of backwardness in rate of economic development. Yet the problem must be solved, and solved in radical fashion, without delay.

I believe that this problem should be solved in a differentiated way, starting with the actual possibilities of each particular enterprise or association. I think it is very important to create a setting wherein each enterprise, as it is prepared, of its own volition— let me emphasize: of its own volition — can begin operating in accordance with the requirements of international or national Western standards. For example, some can do so already, while others only after a certain time. Some can comply with all requirements of the world market, others only with a portion. Let the enterprises themselves decide. The main thing, they should know the requirements with which they must comply for their products to be competitive. It is very important for everyone to know the Western requirements, and for this the respective normative documents should be universally available. Here lies the solution to the problem of providing the enterprises with the necessary information for forecasting and planning the technical level and quality of products. As for the time frame of converting the enterprises and associations to operate on Western standards (or in compliance with their requirements), the details, tactics and strategy of this are a transition to international and national Western standards. Only in this way can we solve the problem of raising the quality of Soviet products to the world level, as formulated by the 17th Congress of the CPSU.

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Analysis and Evaluation of Effectiveness of Financial Incentives for the Personnel of a Machine Manufacturing Enterprise in Self-Financing Conditions

18610010b Moscow VESTNIK MASHINOSTROYENIYA in Russian No 7, Jul 88 pp 63-65

[Article by L. T. Gilyarovskaya, candidate of economic sciences]

[Text] Acceleration of the socioeconomic development of the country involves a faster pace of economic growth, resulting from universal intensification of production on the foundation of using the achievements of scientific and technical progress, restructuring of the economy, adoption of effective forms of management, organization, and work incentives. Hastening of the socioeconomic development of an enterprise—the central link in the national economy—is largely assisted by extensive use of economic levers and stimuli, progressive forms of labor organization, and effective systems of moral and financial work incentives.

In self-financing conditions, a significant change occurs in the financial incentive systems. On the one hand, they should enable an organization of highly productive, intense work, involving the workers in accelerating the growth rate of production and retooling of the enterprises, raising the quality of products, increasing the output of new and progressive equipment, and creating a cost-controlling management mechanism. On the other hand, the action of effective work incentive systems strengthens the social equitability, improves the working conditions, increases the capital-labor ratio and, on this foundation, reduces the proportion of manual labor, increases the average wage, and increases the payments and benefits from the social development fund. All of this ultimately helps bring together the interests of society, the work force, and the individual on behalf of implementation of the national economic interests, universal activation of the human factor, radical restructuring of the economic management of the enterprises on the basis of economic methods. Toward this end, all forms of financial remuneration, encouragement, bonuses, overtime, payments and benefits should be used extensively, distributed in dependence on the quantity and quality of work performed, the outcome of the work, taking into account the contribution of each factory worker in achieving the common goals.

At the machine manufacturing enterprises, the forms and systems of financial encouragement of work are being implemented by means of a large number of specific sources. However, in the economic literature, financial encouragement of work is often identified solely with bonuses from the wage fund and the financial encouragement fund. The forms of financial work incentives currently practiced do not yet make full use of the tariff component of the wages, extra payments and raises from the wage fund and its savings, onetime payments from the financial encouragement fund, other monetary payments and the value of distributions in kind to the workers and employees which are not part of the wage fund, as well as all resources of the social development fund. All these resources should be paid out only when excellent end results of economic activity are achieved, the growth rate of which should surpass the growth rate of mean annual payments per worker of the enterprise from the aggregate of financial encouragement sources of the entire work force of the enterprise.

Inadequate development of a methodology for financial work incentives will have negative results on the assessment of effectiveness of financial work incentives in routine management, preventing full utilization of all sources in solving the socioeconomic problems of the

management activity of the enterprise. Because of the lack of far-reaching theoretical and methodological thinking on this problem, at present there is no quantitative measurement of the degree of effectiveness of using the entirety of financial work incentive sources at the machine manufacturing enterprises, and the effectiveness of use of the wage fund is basically evaluated by consideration of payments from the financial encouragement fund (without the onetime subsidy). For this, the ratio between the growth rate (increment) of the average wage, including payments from the financial encouragement fund (without the onetime subsidy), and the growth rate (increment) of labor productivity is computed.

The comprehensive approach to evaluation of effectiveness of financial work incentives aims at identifying, first and foremost, the entire spectrum of sources (resources) used to this end. Financial encouragement sources include: the wage fund; the unified financial encouragement fund, including the financial encouragement fund and the special bonus funds (resources) for creation, commercial development, and introduction of new equipment or technologies, handover of scientific and technical accomplishments, production of export items, production of consumer goods from manufacturing wastes, development, commercial readying, and production of general technical items, commercial readying of planned facilities and placement in operation of construction sites, promotion of inventiveness and efficiency proposals, collection and handover of industrial wastes for recycling, and so on; the social development fund; other means of encouragement, payment and benefits not presently part of the wage or unified financial encouragement funds. The totality of all these funds and means of financial work incentives will then constitute the total sum of the unified work force financial incentive fund of the enterprise.

The processes of formation and effectiveness of use of each resource of individual financial work incentives and of the collective (unified) financial encouragement resource fund are a constituent part of the cost accounting activity of all elements of management. It should be noted that, while the general methodological and organizational aspects of the financial work incentive mechanism are developed in sufficient detail by political economics, and certain results have already been achieved in this area, the analytical accounting aspects of this program have not yet been studied sufficiently. There is no procedure for analysis and evaluation of the effectiveness of financial work incentives.

For the practical running of every enterprise it is essential to know the amount of resources from the various sources altogether spent by the enterprise on work incentives, as well as the degree of correspondence between expenditures and work results. From the standpoint of the national economy, it is important to ascertain whether all means of remuneration of work without exception and regardless of how distributed (as wages, bonus, expense-paid vacation to a spa, traveling expenses, financial subsidy, etc.) are supported by the volume of goods. In the final analysis, it is necessary to determine the degree of effectiveness of utilization of the entire collective enterprise work force incentive resource fund, i.e., it is necessary to relate the amount of expenditure of the fund to the end results of the economic activity.

The formation and use of the united work force financial incentive fund is both an element of the socioeconomic activity of the enterprises and an element of economic analysis, which studies the economic process in its relationship with other processes. Given the use of intensive methods of management, especially in regard to the conversion of the enterprises to total cost accounting and self-financing, with increased independence and responsibility for the results of the economic activity and the social development of the work force, the issues of deliberate and effective use of both the aggregate financial work incentive fund and each individual component thereof, evaluation of the results of using the financial work incentive system and the degree of its influence on raising the labor productivity and the involvement of the workers in this process, and identification of factors holding back the process of higher pay and work incentives take on special urgency.

The present system of accounting computes the amount of the unified work force financial incentive fund actually charged to the entire work force for the year, including the industrial workers. The effectiveness of utilization of the resources of the fund can be defined as the ratio between the end results of the economic activity (volume of product N or profit P) and the outlay of resources on financial incentives of the enterprise work force. The effectiveness of work force incentives can also be expressed by a number of partial indexes:

The incentive-product ratio α, being the ratio between the unififed work force financial incentive fund resources and the volume of manufactured product (α=fund:N), and the profit-incentive ratio β, being the ratio between the profit and the total expenditures on work financial incentive (β=P:fund).

The reserves for lowering the incentive-product ratio and increasing the profit-incentive ratio can be evaluated through a system of interrelatedjfactors. Formulas for calculating the degree of influence of the various factors are presented in Bakanov, M. I., Sheremet, A. D., "Teoriya analiza khozyaystvennoy deyatelnosti [The Theory of Analysis of Economic Activity]," Finansy i statistika, M., 1987, 102 pp.

By the method of chain substitutions or the integral method of factorial analysis, the influence of the factors on change in the incentive-output ratio and the profit-incentive ratio during the fiscal period as compared to the previous is calculated, disclosing the reserves for boosting the effectiveness of utilization of incentive fund resources and the factors holding back such growth.

This system of indexes only provides an idea as to the partial results of evaluation of the effectiveness of utilization of incentive fund resources at the enterprises. Such analysis should be performed on the basis of data from an analytical table, using (for example) the parameters of effectiveness of financial incentives of the work force of a machine manufacturing enterprise during the accounting quarter.

But in general, the system of partial indexes cannot clearly evaluate the degree of effectiveness of utilization of this fund. It is therefore advisable to employ an integrated generalizing characteristic to evaluate the effectiveness of utilization of all work incentive resources $E_{f.i.}$, computed by the formula $E_{f.i.} = K_j/K_{w.f.i.}$, where K_j is a factor characterizing the integrated estimate of economic activity from the end results of work during the year; $K_{w.f.i.}$ is a factor for the growth in mean annual payments from the unified work force financial incentive fund per single worker, calculated as the ratio between mean annual payments (in rubles) from the fund during the reporting period and those of the previous period (cf. table): $K_{w.f.i.} = B_1:B_0 = 691.4:635.4 = 1.088$.

To calculate the factor of the integrated estimate of economic activity from the end results for the year K_j, we first compute the growth rates of the following factors: the volume of production (0.955); the labor productivity (0.961); the proportion of superior quality products (1.301); the profit (0.863); the return on investment (0.893); the utilization factor of production facilities (0.974); the reciprocal of the costs per ruble of commercial product (0.995); and then calculate the generalizing integrated factor of the estimate of work results by the formula:

$$K_j = \sqrt[n]{\prod_{i=1}^{n} x_i},$$

where

$$\prod_{i=1}^{n} x_i$$

is the product of factors characterizing the present growth rates of the parameters selected for the generalized estimate of economic activity of the enterprises; n is the number of parameters in the estimate of the economic activity.

Parameter	For the corresponding period of the previous year	For the fiscal period	Deviation (plus, minus)	Growth rate, percent
Unified work force financial incentive fund, thousands of rubles	7584	8171.3	plus587.3	108.1
Average work force, persons	11382	11309	minus73	99.4
Expenditure of incentive fund resources per ruble of product (incentive-output ratio), rubles	0.5712	0.6466	plus0.0754	113.2
Profit per ruble of product, rubles	0.408	0.368	minus0.04	90.2
Profit per ruble of incentive fund (profit-incentive ratio), rubles	0.714	0.57	minus0.144	79.8
Normative pure production, thousand rubles - x_1	12662	12094	plus568	95.5
Product output per worker, rubles - x_2	1112.46	1069.41	minus43.05	96.1
Proportion of superior quality products in overall product volume, percent - x_3	32.9	42.8	plus9.9	130.1
Bottom-line profit, thousand rubles - x_4	5165	4457	minus708	86.3
Return on investment, rubles - x_5	0.263	0.235	minus0.028	89.3
Coefficient of utilization of production facilities for commercial product, percent - x_6	86.4	84.1	minus2.3	97.4
Expenditure per ruble of commercial product (reciprocal), rubles - x_7	1.3053	1.2989	minus0.0064	99.51
Mean annual payments (B) from incentive fund per worker, rubles	635.4	691.4	plus56	108.8
Ratio of growth rates of product output and growth rates of mean annual payments from incentive fund per worker	x	x	x	0.8833
Ratio between growth rates of production and growth rates of volume of incentive fund resources	x	x	x	0.8834
Ratio between growth rates of profit and growth rates of volumes of incentive fund resources	x	x	x	0.7983

x- These parameters not calculated

According to the table data, K_j=0.9849. Then, the factor of effective utilization of incentive funds will be $E_{f.i.}$ = $K_j/K_{w.f.i.}$ = 0.9849:1.088 = 0.9052

Consequently, the present integrated system of work force financial incentives is not running effectively.

Using this system of partial and generalized characteristics, we can find the degree of effectiveness of utilization of the aggregate financial work incentive resource fund as a function of the accomplished end results of economic activity of the enterprises. The proposed system of parameters for analysis and evaluation of effectiveness of utilization of work incentive resources can be used at all enterprises of the industry operating in self-financing conditions.

Center for Heat Treatment of Tools To Open in Moscow

18610144c Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian No 234, 11 Oct 88 p 2

[Text] Extract: Quenching, annealing, electroslag remelting, hardening and anticorrosion treatment of tools are only some of the services that will be offered by a commercial center for heat treatment of products which is being created in Moscow.

A. Popov, general director of the "Elektroterm" research and production association, told about this center at the editor's request.

"In the United States, 80 percent of tool products undergo various types of strengthening heat treatment, but only one-fourth as many receive such treatment in our country.

"What is the reason for this? The Soviet vacuum-plasma unit 'Bulat' heightens the wear resistance of drill bits by almost nine times and that of milling cutters by 30 times! But only a large enterprise can acquire such costly equipment. Moreover, highly skilled specialists are needed for maintenance of the 'Bulat,' but there are really not enough of them.

"Our center will solve these problems. Any Moscow enterprise can become a customer of the center. Such a customer has only to deliver parts that need hardening to the center, and the order will be filled by the earliest possible date. Our country has had no experience with enterprises like the center until now, but we hope that no one will suffer because of this."

UDC 621.9.06.002(497.2)

Bulgarian Machine Tool Building Industry

18610406d Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 88 pp 43-44

[Article by Engineer A.N. Ivanov under the rubric "Foreign Technology"]

[Text] In the last two years, a new stage in the development of the Bulgarian machine tool building industry has begun: the development of automated technological modules (ATM) built-in into automated complexes.

The SP-161 automatic bar-stock lathe for machining steel bar stock 8 to 160 mm in diameter and light alloy bar stock 16 to 300 mm in diameter. The lathe has a spindle head with a variable speed asynchronous electric motor; it also has a 12-position turret head with 6 axial and 6 radial tool pockets.

When the lathe is built-in into an ATM, workpieces are changed automatically by means of a 10-kg gantry manipulator.

ST semiautomatic lathes (ST161, ST201 and ST251) can machine parts 160, 200 and 250 mm in diameter. The carriage is mounted in such a way that the area next to the spindle remains open. This makes it possible to machine large-size parts (up to 520 mm in diameter). ST lathes operate in modules with RB242 robots; they have a bar stock feeding device and an operator for accepting finished parts. When using a turret tool holder with rotating spindles, the lathe can operate as a turning and broaching milling center.

Semiautomatic NC lathes with horizontal guides are designed for machining parts made of ferrous and nonferrous metals clamped in a chuck or between centers. Diameter of machined parts is up to 580 mm, length up to 1,370 mm, mass up to 1 ton.

A speed gearbox makes it possible to automatically select nine rotational speeds, from 60 to 250 RPM. The tooling system has two electromechanical turret heads. The front head is disk type; it has a horizontal axis of rotation and six positions. The rear head has four positions and a vertical axis of rotation. The lathe is a self-contained NC unit. Cutting speed is 200, 400 and 800 RPM for 25, 50 and 100 mm diameter parts, respectively. Tool change time is 3 s.

Vertical semiautomatic NC lathes (models SV201, SV321 and SV501) for machining parts 200, 320 and 500 mm in diameter. Their advantage is the use of a part weight for orienting it relative to positioning surfaces of the chuck. The small footprint facilitates organization of an automated traffic flow. Each model can be supplied with one or two spindles and one or two carriages.

Semiautomatic lathe, model SS013, for diamond machining of aluminum disks for magnetic storage devices performs fine turning, using diamond tools, of surfaces of aluminum disks for computer magnetic storage devices. Machined surfaces are characterized by good planarity and excellent surface finish. The lathe frame is made of special granite, which ensures high precision of carriage travel; the carriage is also made of granite. Maximum disk diameter is 360 mm, main drive capacity is 2.2 kW, spindle rotational speed is 250-4,000 RPM. Working feed is 0.02 to 0.1 mm/revolution, speed along axes X and Y is 10 m/min. Lathe mass is 2.5 tons.

Machining centers with a vertical spindle (models RV501.16 and RV 501.24) are designed for machining prismatic base members with the side size of up to 500 mm and flat parts. Using these centers, one can perform flat, complex and contour milling and hole broaching. The main drive has a variable speed d.c. motor with hydraulic range switching. Three types of the main gate are provided, with maximum rotational speed of 4,200 RPM.

Main drive capacity is 8, 11 or 15 kW. Work table size is 1,000 x 500 mm. Tools are changed automatically (16- and 24-tool magazines). Cutting speed is 280, 560 and 1,120 RPM for 25, 50 and 100 mm diameter parts, respectively. Tool change time is 8 s. On the basis of the RV 501.24 machining center, a module with a new NC system and a device for controlling the integrity of small-size tools has been developed. This ensures automatic operation of the module for one shift without operator's interference.

Machining center TsM040 is designed for machining parts made of ferrous and nonferrous metals.

The main drive (7.5 kW) has continuously variable speed adjustment (spindle head rotational speed is between 45 to 4,500 RPM). The large diameter of the gear connector ensures good table stability. The center is manufactured with two tool magazine modifications, for 20 and 30 tools. Basket changing (two positions: for a basket with blanks and a basket with finished parts) that uses lathe slide travel for removing or installing a basket with the part to be machined makes it possible to use an automated guided vehicle.

Basket change time is 25 s. Cutting speed is 350, 700 and 1,400 RPM for 25, 50 and 100 mm diameter parts, respectively. Surface finish Ra=2. Tool change time is 6 s. Chips are removed by a special screw conveyor.

Five-coordinate machining center MC032 is a high-output machine for parts that fit in a 320 mm diameter and 280 mm high cylindrical envelope and require considerable machining time due to their intricate configuration and the need to perform various kinds of machining at the same position of the work table. The center can perform complex broaching, milling, thread-cutting etc. operations at various angles when machining parts made of ferrous and nonferrous metals. Mass of machined parts is up to 100 kg. The spindle is driven by a 7.5-kW variable speed asynchronous electric motor with two rotational speed ranges (from 10 to 600 RPM). Travel along axes X and Y is actuated by a spindle box. Travel along axis X is used for changing tools in a 24- or 32-socket disk-type tool magazine. Cutting speed is 380, 750 and 1,520 RPM for 25, 50 and 100 mm diameter parts, respectively. Surface finish Ra=2. Accuracy of work table rotation is within 15 seconds of arc. Tool change time is 12 s.

The ShK322.41 semiautomatic circular grinder is designed for grinding outside surfaces of cylinders and face and profiled surfaces of multistep shafts, such as spindles of metalworking machine tools and shafts of electric motors, water pumps, centrifuges etc. The machine makes it possible to grind parts of different diameters with one installation. Grinding spindle motor capacity is 17 kW, grinding speed is 10 m/min.

The grinder is equipped with transducers that cut down unproductive time, which ensures a high production rate. The grinding spindle is installed in precision hydrostatic bearings, which ensures high precision of rotation and maximum longevity. The grinding carriage and the longitudinal table slide along plastic-coated V-shaped and flat slides. It can be supplied with one or several active control devices mounted on the table, or with a wide-range device for automatic measurement of steps that have various diameters. Control of the machine is combined with the NC control system. Tool travel accuracy is from 2 to 10 micrometers. Surface finish Ra=0.16.

The ShK324.32 semiautomatic NC circular grinder for ID and OD grinding works with one installation of short parts, such as flanges, gears, bushings etc., in the chuck. Dimensions of the grinding disk for OD grinding are 750 x 80 mm; tooling for OD grinding is selected depending on the technological problem that has to be solved. ID and OD grinding are performed according to program. OD grinding speed is 45 m/s, that of ID grinding is 35 m/s. Tool travel accuracy is between 2 and 10 microns. Surface finish Ra=0.16. A tool magazine with automatic tool changing can be built-in.

OL400A automatic band saw for cutting round and shaped stock made of ferrous and nonferrous metals in single-piece and automatic operating cycles. Band speed is adjusted depending on material hardness. Constant band tension is maintained automatically. Chips are removed from the cutting zone by a special conveyor. After cutting has been completed, the band swings out of the way automatically.

Specifications

Maximun workpiece size:	
Round diameter, mm	400
Square,mm	400x400
Cutting speed, m/min	up to 140
Mass, ton	2

ISKAR automated industrial laser system is designed for cutting sheet metal up to 6 mm thick. It can cut parts with intricate configuration in small-series production.

Specifications

Travel along axes X and Y, mm	1100
Maximum sheet metal size, mm	1000x2000
Positioning speed, m/min	up to 8
Cutting speed, m/min	up to 4
Sheet clamping	pneumatic

"Prometey" programming system. The basic version of the system is realized on the basis of the INTELLE AT 16-bit personal microcomputer (IBM PC-AT-compatible). It operates under the control of the widely used MS-DOS operating system.

Use of this system provides significant advantages compared to traditional production methods:

- fast interaction with the sy[illegible] in an interactive operating mode;
- considerably less time and fewer personnel needed for writing control programs and punchtapes for NC machines;
- the use of a 16-bit personal computer, with no additional hardware needed for functioning;
- significantly easier programming, because programs for parts are coded using an input language (the CM ART version of the ART language);
- the capability of scrolling graphic part images in the overall and detailed nesting plan, which ensures high accuracy when parts are positioned within an arbitrary size envelope.

Being developed as an expert CAD/CAM system, the "Prometey" ensures the fastest compilation of the optimum version of the nesting drawing, while making it possible to:

- fast and efficiently manipulate parts by using elementary commands "Move", "Rotate" and "Copy" specified by a function key or a lever pointer;
- automatically duplicate parts in a given direction, until exhausting the number of parts or reaching the contour or a sheet edge;
- get a mirror image about axes X or Y;
- magnify portions of the nesting drawing;
- change the sequence of cutting parts;
- change starting points of cutting for individual parts;
- cut out parts or groups of parts using the nesting drawing, etc.

Technological requirements on the cutting process (gas, plasma and laser) are taken into account using an expert system, which provides automatic sorting of parts by size and automatic display of parts, and ensures optimum technological parameters of cutting.

Using the system, one calculates standards for consumption of material and labor resources for an appropriate process of thermal cutting and develops technological documentation (technological charts and punchtapes) for control of the manufacturing process.

Using the system, one controls NC machines in a standalone mode using a punchtape, or by direct control (DNC).

The system can be integrated and combined into a programming complex with user's CAD systems.

The system offers a macrolibrary which makes it possible to determine configurations of over 100 parts most often used in today's production, which sharply reduces programing expenses.

Multipositional Industrial Robots With Cyclic Control

18610159 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 3, Mar 88 pp 5-6

[Article by I. I. Pavlenko, candidate of technical sciences]

[Abstract] A modular multipositional industrial robot has been developed. The RTs6-P10 robot for loading and unloading metal-cutting machine tools or other equipment has two grips and a pneumatic drive with cyclic control. It is designed for six degrees of freedom and a total lifting capacity of 10 kg. Each arm can travel 320 mm horizontally at a speed of 1 m/s and 200 mm vertically at a speed of 0.5 m/s, can also rotate through 240° at a speed of 90°/s, while each wrist with grip can rotate through 180° at a speed of 180°/s. The two linear-positioning mechanisms include a damper each, the positioning accuracy being within 0.2 mm, and the angular-positioning mechanisms including a frictional disk brake. The robot weighs 300 kg and the dimensions of the base are 850x580x660 mm^3. Figures 2; tables 1; references: 8 Russian.

UDC 007.52

Quasi-Optimum High-Speed Adaptive Control of Electric Drives of Robot Manipulator

18610215 Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30 No 11, Nov 87 (manuscript received 19 Feb 87) pp 15-20

[Article by F. V. Furman, A. P. Pashkevich and Ye. P. Kukareko, Minsk Institute of Radio Engineering]

[Abstract] A quasi-optimum high-speed adaptive position control is synthesized for electric drives of a robot manipulator on the basis of a mathematical model which has the object decomposed into a set of isolated subsystems with indeterminate parameters interrelating the various degrees of freedom. "Dry friction" effects are approximated as perturbations and the electromechanical coupling coefficient is assumed to remain quasisteady. As in synthesis of optimum regulators, a phase portrait of the control object is constructed, the equation of the optimum switching line is found, and the control action is determined which will ensure transfer of the object from initial state to final state within minimum time without loss of stability. This control covers a wide

range of values of the electromechanical coupling coefficient while it does not require, as does optimum control, exact solution of the problem for a piecewise-constant control function with discontinuities which depend not only on the initial conditions but also on the object parameters. The algorithm of such quasi-optimum control was tested, and validated, by simulation of a robot manipulator rotating a column through an angle of 0.37 rad with the arm vertical and the gripper carrying no load, with the arm horizontal and the gripper carrying a mass of 10 kg, and with simultaneous movement in three degrees of freedom without load. Article was presented by Department of Automation and Telemechanics. Figures 3; references 5: 4 Russian, 1 Western.

UDC 681.586.32

Transducers and Adaptation Systems for Industrial Robots and Flexible Production Systems; Present and Future

18610203 Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 9, Sep 87 pp 27-30

[Article by V. A. Bakushev, candidate of technical sciences]

[Abstract] Current developments relating to introduction of second-generation industrial robots and flexible production systems worldwide are reviewed, specifically those in the area of transducers and adaptation systems. Six groups of them are identified from the standpoint of distinctive design and performance characteristics for: 1) technical vision; 2) detection of objects; 3) ranging of objects; 4) identification of objects by code readout; 5) nondestructive inspection and quality control; 6) execution of vocally transmitted instructions. Spektr NPO in Moscow has been very active in these developments, its designs meeting market requirements projected up to the year 2000 and being comparable with those by American, Japanese, and West European manufacturers. Among the Spektr robots already in operation at various production plants, one has technical vision for quality control of laminations during assembly of induction motors, one has an acoustic defectoscope for quality control of disk brakes during a tractor assembly, and one has an x-ray television introscope. Tables 2; references 1: Western.

UDC 658.52.011.56.005:658.512.4.011.56

Integration of Process Planning and Control in Flexible Manufacturing System

18610193a Moscow STANKI I INSTRUMENT in Russian No 3, Mar 88 pp 2-3

[Article by A. I. Alikov, Ya. D. Penek, P. V. Volotsenko and M. L. Margul]

[Abstract] Integration of process planning and automatic control is required for adaptation of a flexible manufacturing system to real conditions, including possible changes of our deviations from original plan and matching them with plant capabilities. A typical example is starting the production of a large lot of parts on several machine tools simultaneously. Such a problem can be solved by checking various processing variants for adequacy of equipment and necessary tool resettings for production around the clock in shifts, with iterations for optimum integration of setup and control algorithms according to whichever criterion applies. Figures 3.

UDC 62-193.2

Intensification of Production Modes of Continuous-Duty Manufacturing Machinery

18610166 Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 88 pp 18-19

[Article by I. A. Klusov, doctor of technical sciences and A. R. Safaryants, candidate of technical sciences]

[Abstract] The possibility of production intensification in manufacturing plants with automatic rotary or rotary-conveyor lines by product diversification is examined on the basis of a time and motion study. The entire kinematic cycle involving a typical continuous-duty machine tool is considered, namely successive movements of the drive and the servomechanism followed by movements of the tool and of the processed item. A nonrotary conveyor scheme, the simplest and basic one, is analyzed with both stability and flexibility requirements taken into account. Four possible variants of diverse production with a machine tool are proposed: 1) stepwise arrangement of tool sets ensuring continuous output of specific different items, 2) automatic change of tool sets for processing of different items, 3) analogous shifting of gears or change of tool sets for conversion of automatic rotary line to conveyor mode, 4) change of entire conveyor line with tool sets or machinery for production of different items without stoppage. Figures 3.

UDC 658.512.011.56:621.9

Sector-Wide System for Minicomputer-Aided Design of Technological Processes

18610193b Moscow STANKI I INSTRUMENT in Russian No 3, Mar 88 pp 3-4

[Article by E. S. Milov, V. M. Shutko and Ya. V. Kovaleva]

[Abstract] One system for computer-aided design of machining processes available to all enterprises of an industrial sector is being developed at the Minsk branch of orgstankinprom [State Manufacturing and Experimental Engineering Institute for Organization of the Machine Tool Industry]. The system is based on a YeS minicomputer and is capable of designing, from the blueprint of a part, all technological processes, routings and control programs necessary for producing the part on NC machine tools. It consists of five on-line data

bases, storing information on the model of the part, process algorithms, ongoing operations and transfers, and normative standards. The data is manipulated by six subroutines for part and blank description, accessing the process algorithms library, process planning, control programming, meeting normative standards and producing documentation. Figures 1.

UDC 658.52.011

Automation of Graphics To Accompany Strength Calculations in Design of Power Equipment
18610173d Moscow
ENERGOMASHINOSTROYENIYE in Russian
No 1, Jan 88 pp 17-18

[Article by Yu. A. Mamychev, engineer, V. V. Tkachenko, engineer, and Ye. L. Kolotilov, engineer]

[Abstract] A computer graphics subroutine has been developed by the Krasnyy Kotelshchik PO and is included in its computer-aided design system. The subroutine automatically follows along with engineering calculations and displays working drawings during each stage of production planning. It tracks the design of pressure vessels for strength by the method of geometrically homogeneous superelements and the method of compliance increments. From input data given in the form of a route sheet, a generalized sketch of the design object is drawn in the form of a oriented graph. The functional software for checking calculations includes, in addition to design graphics program packages, also monitoring and servicing program packages. The programs are written in FORTRAN for a YeS-1033 computer. The results of calculations are not only displayed in the form of stress diagrams but also printed out in alphanumeric form. Figures 2; references 1: Russian.

UDC 658.011.56.001.63:681.3

Methods of Including Graphics in Computer-Aided Design System
18610173c Moscow
ENERGOMASHINOSTROYENIYE in Russian
No 1, Jan 88 pp 14-16

[Article by A. V. Shestakov, engineer]

[Abstract] Inclusion of graphics in a computer-aided design system is described, graphic display of information being a necessity for the engineer as design supervisor. Graphics include visual means of tracking design activity and geometrical models as well as drawings describing the design object. The graphics subsystem of a computer-aided design system includes, accordingly, hardware and software for construction and correction of geometrical models, for loading the database, for graphical tracking, and for producing blueprints along with other drafting documentation. Figures 2.

UDC 658.011.56.001.63:681.3

Conversion of Models in Computer-Aided Design System
18610173b Moscow
ENERGOMASHINOSTROYENIYE in Russian
No 1, Jan 88 pp 11-14

[Article by A. V. Suvorov, candidate of technical sciences]

[Abstract] Conversion of physical models used for manual design to modular mathematical models for computer-aided design is described, the aim of this conversion being a more efficient programming. Both design and optimization models are considered, together with structural constraints and strength constraints applicable to power generation equipment. The software structure for such a conversion includes software packages for construction of reference models and entering them in the database, as well as for design calculations. Figures 1; references 9: 5 Russian, 4 Western.

UDC 658.011.56.001.63:681.3

Trend of Developments in Use of Computer-Aided Design Systems in Power Machinery Manufacturing Enterprises
18610173a Moscow
ENERGOMASHINOSTROYENIYE in Russian
No 1, Jan 88 pp 6-9

[Article by N. G. Malyshev, doctor of technical sciences, and Z. G. Usubov, candidate of technical sciences]

[Abstract] Developments in the use of computers for product design fall into three stages. The first stage is writing individual highly specialized programs for engineering calculations. The second stage is introduction of features such as modular software layout, convenient data input/output formats, peripheral memories for intermediate data storage, and programs containing new mathematical algorithms. The third stage is completing the computer system for comprehensive design, fully automatic or semiautomatic in tandem with manual design. Providing the complete hardware for computer-aided design in a power machinery manufacturing enterprise requires first organizing independently a YeS computer complex and an SM minicomputer complex or a minicomputer-based automatic work station, then combining them into a two-machine system with minimal configuration for solution of difficult application problems within a narrow scope. The system must then be expanded into a LAN with a powerful central computer so as to ensure higher reliability and productivity. As to the software, both the MEMO system or variations of it, developed at the Tallinn Institute of Cybernetics (ESSR Academy of Sciences), and the "Kashtan" system developed at the Kiev Institute of Cybernetics (UkSSR Academy of Sciences) are now in use. While the MEMO system can operate in the "swapping" mode, with temporary transfer of programs from main to virtual memory, the "Kashtan" system provides for "dynamic" control of the design process. Important items to consider in

construction and use of a computer-aided design system are assurance of a high information content, adaptability to a two-stage heuristic design process, adaptability to extensive use of numerical methods for solution of differential equations and optimization problems, and also capability for interactive machine graphics.

UDC 621.865.8-113:621.757.06

New Manipulator Mechanisms
18610195a Moscow MASHINOSTROITEL in Russian No 3, Mar 88 pp 11-12

[Article by V. D. Darovskikh, engineer]

[Abstract] Two new mechanisms have been invented which will enable an automatic manipulator to perform several operations simultaneously such as assembling or otherwise processing a part while transporting and orienting it. The first one (USSR Patent Certificate No 1,215,993) consists essentially of a meshing gear pair, the pinion driven by an electric motor, their hubs rigidly connected to a tie bar and mounted on a shaft each. The shaft of each is held in two bearings the bearings of the two shafts being pairwise coupled through cross-arms and the two cross-arms being mounted through bearings in a common frame. The second one (USSR Patent Disclosure No 4,183,526) consists essentially of a stationary frame which carries a shaft driven by an electric motor and coupled through clutches to a hollow shaft and correspondingly a tie rod on each side. Figures 2.

UDC 621.941.23-.529.229.621.9.014

Selector Device of Cutting Modes on NC Lathe
18610195c Moscow MASHINOSTROITEL in Russian No 3, Mar 88 pp 22-23

[Article by S. Ye. Ushakova, doctor of technical sciences, A. A. Vyaltsev, candidate of technical sciences, and I. K. Kuznetsova, engineer]

[Abstract] A selector of cutting modes on an NC lathe (such as Elektronika NTs-31) has been designed which will facilitate prompt and convenient selection of the most appropriate cutting mode in a small-scale production plant. It consists of six dial disks mounted on a common shaft in the "circular slide rule" manner, with reference data tabulated on the inner four and windows cut in the outer two showing the selection as the inner disks are rotated. The information on the disks is sufficient for rough contour and hole cutting, fine contour and hole cutting, internal and external groove cutting, hole drilling, and multipass metric threat cutting. The data, laid out logarithmically, facilitate correction of cutting rate and feed rate upon change of tool and part geometry as well as the setting of spindle speed for given cutting rate and part size. The data have been compiled for six groups of materials to be cut and include the appropriate tool material for each, these groups being: Al alloys, Cu alloys, cast irons, structural plain carbon steels, structural alloy steels, and stainless steels. Figures 2.

UDC 621.787.044.4

Dependence of Metal Surface Microhardness on Pressure Force and Tool Vibration Amplitude During Ultrasonic Nonabrasive Treatment
18610230 Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 1, Jan 88 (manuscript received 5 Jun 87) pp 143-146

[Article by N. R. Selimov, engineer, and Yu. V. Kholopov]

[Abstract] In an experimental study concerning ultrasonic nonabrasive treatment of soft steels, measurements of the surface microhardness were made for a determination of its dependence on the tool pressure force and vibration amplitude. Flat strips of 08 kpg steel, 0.8 mm thick with an initial Vickers microhardness of 937 MPa, were tested with an ultrasonic tool moving over the surface in the longitudinal-transverse oscillation mode. The tool pressure was varied over the 10-400 N range and the tool velocity was varied over the 0.122-0.350 m/s range, with the 0.4 kW oscillatory ultrasonic drive operating at a frequency of 22 kHz. The surface microhardness was measured with a PMT-3 tester using a 0.5 N load. The results indicate that ultrasonic treatment hardens the surface of a soft steel, the maximum microhardness corresponding to an optimum combination of tool pressure force and vibration amplitude which depends on the velocity of the tool. Figures 3; references 3: all Russian.

UDC 621.74.04:669.14

Design of Foundry Equipment for Large Steel Castings
18610182a Moscow ENERGOMASHINOSTROYENIYE in Russian No 3, Mar 88 pp 33-36

[Article by V. I. Nazarov, engineer, G. F. Velikanov, candidate of technical sciences, I. N. Primak, candidate of technical sciences and P. F. Vasilevskiy, doctor of technical sciences]

[Abstract] At the Nevskiy Plant, one of the major producers of large steel castings (up to 30 tons) for steam and gas turbines, new materials consisting of refractory fillers such as disthene-sillimanite or zircon and binders such as liquid glass or furan resin with special modifiers have been introduced in the manufacture of molds and cores. The design of this equipment, conventionally based on the G. M. Dubitskiy formula, required an appropriate empirical refinement. Accordingly, first the length of time the new materials can withstand action of molten metal before breaking down thermally was determined. The probability to flaw development was, for this purpose, estimated on Bienisch-Patterson specimens. Next was determined, with high precision, the length of time of metal flow from the stopper-cup ladles, depending on the size of castings to be produced. Finally the minimum permissible linear velocity of metal rise in a mold and the optimum metal pouring velocity were established. With these data available, it is possible to select appropriate ladles with the necessary

stopper diameter for various standard casting sizes, also to recommend the length of time of metal flow through the main casting channel. Tables 6; references 3: all Russian.

UDC 621.787.4;621.787.4.07

New Method of Hardening Thin-Walled Parts
18610195b Moscow MASHINOSTROITEL in Russian No 3, Mar 88 pp 21-22

[Article by V. A. Isayev, candidate of technical sciences]

[Abstract] A new method of hardening the wearable inner journal surface of nonuniformly rigid thin sleeves has been invented (USSR Patent Certificate No 1,204,366) which involves driving a planetary set of rollers around the sleeve cavity, their diameter not exceeding one tenth of the sleeve bore and their number depending on their arrangement inside the sleeve. The uniform radial load on the rollers is 10 to 15 percent more than that which leads to formation of plasticity centers in the contact region; an additional locally-impulsive load with axial and tangential components is also applied. The magnitudes of both loads, and the direction of the latter, are determined analytically and then adjusted experimentally for adequate cyclic strain hardening of the journal surface. With the tooling designed and built at the Moshok (Vladimir Oblast) Auto Repair Plant, this method was successfully tested under laboratory conditions. Figures 2.

Future Civilian Job of Missile-Transporter Vehicles

18610434 Moscow DAILY REVIEW: TRANSLATIONS FROM THE SOVIET PRESS (APN) in English 6 May 88 pp 1-3

[Article by Igor Rozov, correspondent for Vechernaya Odessa, under the rubric "Around the Soviet Union"]

[Text] It would not be an exaggeration to say that all sober-minded people on this planet hope that the Soviet-American Treaty on the Elimination of Intermediate- and Shorter-Range Missiles will be ratified. The work force of the Odessa High-Duty Crane Building Amalgamation is no exception in that sense. However, in addition to the commonly shared interest, people who work there have special reasons to look forward to the ratification—a major project that holds out a promise of a neat profit for the Amalgamation, one of Odessa's largest manufacturers, depends on the outcome of the ratification process.

Nikolai Andrienko heads the State Development Centre that designed many high-duty cranes which made a fairly good showing in the national economy. Several years ago the Odessa Amalgamation established business contacts with Poland's Bumar, also a crane manufacturer, and last year it found another business partner:West Germany's Libherr.

"It was during Mikhail Gorbachev's visit to the United States that we got the idea of using SS-20 missile transporter vehicles as a chassis for a giant mobile crane with a high cross-country capacity," Nikolai Andrienko told this correspondent. "Such cranes could be used for a variety of civilian jobs, notably the construction of bridges and industrial buildings. Our designers had only a short time to come up with the concept design. We had only several weeks because many other manufacturers needed high-duty transporter vehicles badly."

True, ministries and department literally bombarded centralised planning agencies with requests. For instance, geologists and oil workers wanted the missile-transporter vehicle chassis for mobile drilling rigs. In such conditions preference was given to those who were the first to come with feasible designs and the necessary production forms and documents.

"We were among the first," Nikolai Andrienko said proudly. "So, the first lot of several dozen chassis is to be made available to us."

How will they be used? The Odessa Amalgamation is currently working on three high-duty crane designs. Two of them are meant for the foreign partners of the Odessa manufacturer. Bumar, its many-year partner, is in fact ready to build the first sample of the machine. Its turning platform and boom developed jointly by Soviet and Polish designers are undergoing tests.

Only a few weeks ago Libherr's representative visited the Odessa Amalgamation. It should be noted that the West German company has been doing business with Soviet foreign trade agencies since 1972 and has delivered cranes to the sum of $400 million to the Soviet Union since then. It was the supplier of 333 specialised cranes used in the early 1980s during the construction of the trans-Siberian pipeline (these are robust machines that can operate at temperatures right down to 58 degrees Fahrenheit). During the recent visit Libherr's representative discussed prospects for cooperation with the Odessa crane manufacturer. Special attention was devoted to plans for the production of a new crane to be based on the missile-transporter vehicle chassis. The partners examined drawings prepared by Odessa designers.

"It is planned to build machines with a weight-lifting capacity ranging from 80 to 120 tons and telescopic booms up to 70 metres long," Andrienko explained. "There is a high demand for such cranes. We are very pleased with the transporter vehicle—it has a high cross-country capacity and is quite economical. We believe that the designers have already done their part of the job and now it's up to production engineers and workers to have their say."

But Gennady Panyushkin, Chief Engineer of the Odessa High-Duty Crane Building Amalgamation, sounded somewhat annoyed. In his opinion, many Moscow-based and local newspapers came up too early with reports about the planned production of cranes on the basis of SS-20 missile-transporter vehicles chassis.

"The Treaty has not been ratified so far, and it's still too early to speak about the mass-production of new cranes," Panyushkin stressed. "We're looking forward to the final decisions of the US Senate and the USSR Supreme Soviet on the Treaty. That will make it possible to get down to business. Let me tell you that Libherr is also waiting for the ratification process to be completed."

"But then," Panyushkin smiled, "you understand that business considerations are not the only thing that makes us so impatient. All of us would like the Treaty to be ratified and the sooner the better."

UDC 621.791.92-242:669.715

Composites for Harder Diesel Pistons

18610010a Moscow VESTNIK MASHINOSTROYENIYA in RussianNo 7, Jul 88 pp 48-50

[Article under the "Non-Chip Machining" rubric by V. N. Chachin, member of the Belorussian SSR Academy of Sciences, G. N. Voloshin, engineer, and G. P. Komlik, candidate of technical sciences]

[Text] The properties of coatings produced by various methods of gas thermal sputtering and facing are mainly dictated by the materials used for this purpose. Therefore, the development and adoption of new effective

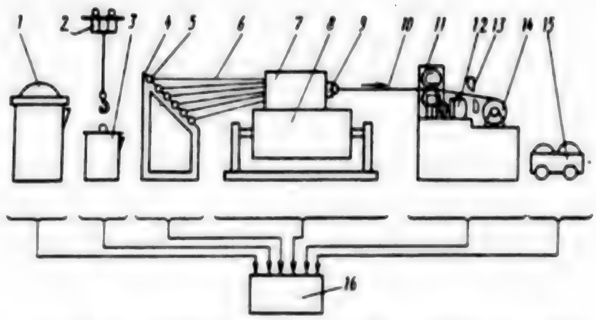
materials for the existing technologies of application of coatings and the equipment used in them take on special importance.

New prospects and capabilities in strengthening technology are revealed by the use of fiber composites in the form of wire, having a base of low-melting metal or alloy (aluminum, zinc, etc.) reinforced with fibers of more refractory metals, alloys, or nonmetals. Such materials can be used in almost all sputtering methods. The presence of the current-conducting base enables broad use of these materials in such highly productive and relatively simple sputtering method as electric arc sputtering. For example, use of a composite on an aluminum base, reinforced with nickel fibers, makes it possible to produce a nickel aluminide coating of high density and strong cohesion with the base. Representing at least a two-phase thermodynamic disequilibrium system with elaborate interface, composites during sputtering enter into an interaction between phases, similar to the familiar plating powders, which favors the formation of an enduring bond between the sputtered coating and the base.

A technological process has been created for continuous production of fibrous composites[1], the essence of which consists in passing separate metallic and nonmetallic fibers through a bath with matrix melt, followed by formation of the composite in a crystallizer with refrigeration. The fibers are pulled continuously through the matrix melt and the composite is extracted from the crystallizer by a drawing device.

This method makes it possible to use low-melting metals like aluminum, zinc, lead and others as the base, or alloys formed from them. The reinforcing elements may be any of the multitude of metal, alloy, or nonmetal fibers produced by the Soviet metallurgical industry. Thus, the possibility of producing materials for sputtering and facing in the form of composite wire, similar or analogous in composition to the currently used powders, such as zinc-aluminum, lead-copper, nickel-aluminum, and other hard-to-deform alloys, makes it possible to combine the advantages of powder and wire types of sputtering and hard facing and substantially enlarges the area of application of these strengthening methods and the technological equipment developed for them.

In the process of integrated investigations of continuous production of composite wires under the aspect of automated manufacturing principles, it was possible to divide the process into separate stages (the primary of which are preparation and inspection of the condition of the fibers, maintaining the temperature and physicochemical condition of the melt, monitoring of the thermophysical processes in the crystallizer, optimization of the composite drawing regime) ascertain the functional relationship between them, and obtain the initial data for construction of an algorithm to control the lower level of the technology system. This served as the basis for development and creation of technological equipment modules for preparation and maintenance of the temperature and physicochemical condition of the melt, formation of the composite (i.e., forming of the composite in an environment of controlled heat exchange with specified distribution of fibers and level of interaction between fibers and melt), and drawing of the composite wire by means of an electric stepping drive with adjustable program control of the drawing parameters. These modules have been realized in a pilot industrial layout for continuous production of composite wire (figure). The advantage of this technological process and layout is the rapid adjustment of the existing technological equipment to production of small wire lots of differing composition, properties, and type size, depending on the particular method of strengthening, plasma, gas-flame, electric-arc sputtering, hard facing, etc.



Layout for Continuous Production of Composite Wire

Key: 1. Oven; 2. Lifting and transport mechanism; 3. Intermediate vessel; 4. Winding device; 5. Reel; 6. Reinforcement fibers; 7. Metal receiver; 8. MDN; 9. Crystallizer; 10. Composite wire; 11. Drawing stand; 12. Ingot drawing drive; 13. Shears; 14. Drum for winding composite wire; 15. Transport cart; 16. Automated control system

The application effectiveness of the composites has been confirmed by an industrial use for strengthening the grooves of aluminum diesel pistons[2], which are becoming one of the weak links in the diesel design, given the constantly rising pressure and temperature in the combustion chamber. The aluminum alloys used for manufacture of the pistons are not able in such conditions to satisfy the contradictory demands imposed on the individual elements of the piston, e.g., the working surfaces of the groove for the upper compression ring. Therefore, Soviet and Western diesel engineering is presently adopting various methods of strengthening the individual elements of aluminum alloy pistons.

One such method allowing substantial increase in heat strength and wear resistance of aluminum alloy in the zone of the piston circular groove is the local remelting method. The essence of this method involves using a directed heat source, such as a compressed arc or an electron beam, to melt the piston blank in the region of

the circular groove, at the same time alloying the remelted metal volume with transitional group elements[3]. As a result, an alloy differing in structure and qualities from the base material of the piston is formed in the remelting zone. This method has major technological difficulties in its practical implementation, owing to the characteristics of interaction of the aluminum alloy melt with the alloy elements being introduced, the nature of the solution of such elements and their distribution in the entire remelted volume, and the formation of the structure of the strengthened zone in the process of cooling and crystallization, which occurs over a short space of time. These difficulties have been overcome by a composite adder material, in the form of aluminum wire with fibers of other metals and alloys distributed in it, which was specially developed for local strengthening of aluminum alloys. At the instant of introducing such material in the zone of action of the heat source directed onto the piston blank, an exothermic reaction is initiated between the aluminum base and the metal fibers, taking place quickly and being diffused throughout the cross section by virtue of the extensive interface surface between the components.

The additional quantity of heat, resulting from the reaction of the elements in the composite, creates conditions for complete dissolving of the introduced alloy elements, a uniform distribution of them throughout the volume of remelted metal, and a quality formation of the strengthened zone. Use of the composite substantially increases the degree of alloying of the aluminum alloy with iron in the region of the piston circular groove to 2.5-3 percent (mass), and its degree of alloying with nickel to 4.5-5 percent (mass), so that a finely dispersed heterogeneous structure is formed in this region with uniform distribution and high volumetric content of strengthening intermetallide phases. This enhances the wear resistance of the piston circular grooves by a factor of 1.5-2[4] and makes it possible to achieve a strengthening effect on the level of the traditional Ni-resist inserts used in Soviet and Western practice.

The developed method of strengthening diesel pistons by plasma remelting is characterized by technological effectiveness, low labor intensity, and high productivity. It makes it possible to regulate the composition and properties of the strengthened zone in wide limits. The method has undergone pilot industrial testing at the production association "Turbomotor Plant im. Voroshilov" (Sverdlovsk) and has been adopted at the production association Kievtraktorodetal. The economic impact was over 100,000 rubles.

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Pipe Usage Practices, Cost, Waste Causes Discussed

18610419 Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 88 pp 2, 7

[Article by Valeriy Stanislavovich Romeyko, subdivision manager, member of the Council of the Scientific-Economical Society of USSR Gosplan: "Cost of Structural Changes: Why Do We Use So Much Steel Pipe"]

[Text] It is a strange situation: our country annually uses as much steel pipe as the USA, Japan, FRG, Britain, France, and Italy put together and, at the same time, pipe continues to be one of the products that is in very short supply. Subdivision manager and member of the Council of the Scientific-Economical Society of USSR Gosplan, Valeriy Stanislavovich Romeyko challenges EKONOMICHESKAYA GAZETA readers to find together an answer to the question of why this is so.

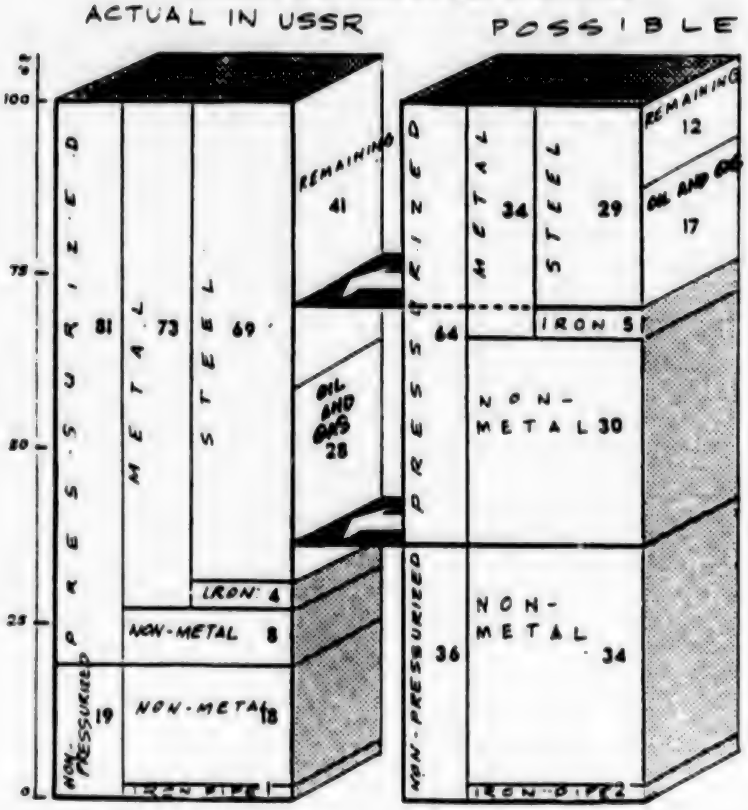
It is no mistake to say that pipe is one of the most necessary parts of a structure. Water and gas enter modern residential buildings through pipes. If we increase the scale of a residential building to the size of an enterprise of a city, the volume and structure of the utilities will also increase, and they represent the life support system of a whole industrial enterprise, complex, or residential development.

Development of fuel and power engineering and agroindustrial complexes, and residential and commercial construction is also impossible without pipes.

What Do We Perceive Through Comparison?

It is known that the value of any product is determined by its usefulness in the application sphere. Pipes are used for two main applications: as pipelines, where most produced pipes are used; and as structural elements in buildings, machines, and mechanisms. Pipelines in all

Structure of Demand for Pipe (in percent)



their diversity (from needles to parts several meters in diameter) may be further conditionally divided into three groups: high-, medium-pressure, and non-pressurized, including drainage pipe. Accordingly, pipes are metal (for high-pressure operation) and non-metal. The determining factor for metal pipe is strength and that for nonmetal pipe is service life.

Let us note two more basic differences. One of these differences concerns pressure and boils down to the fact that supplying pipelines are, as a rule, pressurized and therefore have a smaller diameter than discharge lines, which work at lower pressure (sometimes, fluid is drained from them by gravity). The second difference is composition and properties of fluid in the pipeline. In most water supply, process, and other pipelines, the discharged fluid has a more complex composition; it is corrosion- and wear-active and contains solid, often abrasive products.

Why do we have to pay maximum attention to these differences? Because the quantitative ratios of pressure-/non-pressure and metal/nonmetal pipes are highly important norms, and it is only these that can assure a balanced structure of pipe demand. It is no secret that due to shortage of non-pressurized and low-pressure pipes, expensive pressurized and, more often, steel pipe is used in a general-purpose manner. In general, it is possible to substantially increase the effectiveness of pipe usage in the national economy, without special additional capital investments, by shifting the demand structure alone.

However, everything is perceived in comparisons and therefore, let us examine Table 1 reflecting two pipe demand structures (in percent of total volume of pressurized and non-pressurized pipe). The first is for the USSR in 1985 and the other is a seemingly possible one calculated from demand volumes in the USA, since it is a country comparable to the USSR with regard to the character and volume of construction and machine building products. Let us note that the second structure is also characteristic of a number of other countries, as confirmed by USSR Gosstroy, and may be considered as a balanced one.

What we immediately see is that the proportion of non-pressurized pipe in the first column is half of that in the second column. In real life this means that the shortage of non-pressurized pipe is made up by using pressurized pipe of any available types.

Comparing the second column with the first, we see that we meet the demand for pipes in non-pressurized systems, including drainage, by "boldly" using all nonmetal

pressurized and cast iron pipe and, to some extent, steel pipe. In this case, the low-pressure systems are left with only steel pipe.

What is the volume of steel pipe needed to meet demand in the national economy? Comparison of the two columns shows that they may and should be at the level of 30 percent of the total pipe volume.

Many specialists explain that this high demand in our country is due to our large and continuously expanding oil and gas production. This is not exactly so. If one excludes from the volume of steel pipe that required by the oil and gas industry in the balanced structure, one will see that other applications require only 12 percent of steel pipe. As for us, we are consuming 41 percent and, as a result, its relative proportion in the demand for steel pipe in 1985 was 2.4 times higher than that required in the balanced structure.

100 Failures per 100 Kilometers

Of course, compared with nonmetal pipe, steel pipe is stronger, methods for connecting them with welding have been developed thouroughly, and it is available at a low wholesale price. . . However, these very properties quite often conceal important shortcomings such as rapid corrosion and frequent cases of the inner surface becoming limed up, especially in water supply systems.

For example, pay attention to the steel pipe which supplies water to a faucet or mixer in an apartment. Its diameter is 2-3 times larger than the diameter of the water flow from the faucet. A logical question arises, namely, why in the age of efficient material consumption a supplying steel pipe with such a diameter is being used. The answer is unambiguous: because of corrosion. The inner surface of such a pipe in some regions of the country is so limed over that a match can barely go through it.

You may argue that a 20 mm diameter is no big deal. . . maybe so, but residents of Novgorod, Tula, Kuybyshev, Chelyabinsk, Omsk, Stavropol Kray, and other regions where water lines are subjected to especially intensive corrosion and liming up, know that even a diameter like this may cause great inconveniences. In order to perceive the scale of the problem, let us go to the North Caucasus.

The local resorts are famous for many qualities, except for the water supply. Therefore, it was decided in the sixties to build the 40 km long Kavminvodskiy branch water supply pipeline here. A pipeline of 1,020 mm diameter originally provided the necessary water supply. However, after 6 years of operation, the flow rate dropped from 85,000 m^3/day to 41,000 m^3/day. The reduction of flow rate made it necessary to build a second 1,220 mm-diameter line of pipe. While the two pipelines were being built and later being operated, the first of them lost two-thirds of its capacity and the second one lost one-third of its capacity. Taking into consideration the importance of the water consumers, it was decided to build a third line of 1,420 mm pipe. And what about pipe consumption? Instead of 9,000 tons, 38,000 tons were used, that is 4.5 times more than actually required. . . More examples. A steel pipeline 1,400 mm in diameter supplying water from the Dnepr to Kharkov after 2 years in operation was covered inside with nodular growth 12-15 mm high, which reduced its capacity to a half of initial. Full-scale studies of a 500 mm steel water pipeline in Naberezhnyye Chelny have shown that after 12 years of operation its hydraulic resistance increased 9-fold and capacity decreased to one-third of the initial values.

Now it is easy to imagine how many such water supply steel pipelines are replaced in the country each year. Calculations made at the Academy of Communal Industry imeni K.D. Pamfilov give the same results: reduction of capacity makes the cost of 1 m^3 of water almost 50 percent higher, and total cost of water in the country is increased by R100-150 million annually. And this is happening at our super-low water rates. We should add that in recent years the intensity of inner corrosion of water pipe and liming have substantially increased as a result of increase in the contamination of surface and underground water, and increased amounts of reagents for water purification.

The corrosion damage of heat supply lines is probably no less than that of water lines. As always, winter reveals serious shortcomings here. There is a total network of approximately 200,000 km of heat lines, including over 20,000 km of main heat transfer pipelines of the USSR Ministry of Power. Even with a 16-year repair cycle for communal heat lines, a number of pipelines require replacement after 4 to 5 years. If during the 10th five-year plan there were 20-40 breakdowns per 100 km of pipeline per year, during the 11th five-year plan this number reached 100. For 1987, the ministries and departments requested an additional 120,000 tons of steel pipe to repair and rebuild the worn out pipelines. As we can see, this is the general and quite dismal situation in the heat supply.

How Our Pipes Are "Dressed!"

Use of steel pipe without reliable protection from highly aggressive media, and in systems and structures where they can be replaced with other types of pipe, is technically and economically unjustified. For example, consumption of pipe in the oil and gas industry is growing progessively. The service life of an old pipeline for maintaining seam pressure in the presence of hydrogen sulfide does not exceed 2-3 years. After that the pipeline must be completely rebuilt. Pipes for this purpose are imported. Some kind of merry-go-round is taking place: namely, the more pipe that is installed for such short life service, the more of them must be replaced.

A premature pipeline failure represents not only unjustified losses of metal and hard currency,if somebody would try to calculate the losses from pipeline failures to the environment due to leakage of oil, gas, and aggressive effluents, disturbance of soil and plant cover, contamination of water bodies, reduction in flora and fauna resources, negative effects on ecological and economical aspects of life in the North and Siberia, the obtained results would force us to approach the problem of pipeline service life in a completely different way.

The steel pipe deficit, unrealized opportunities and losses experienced by the national economy due to low quality of pipe and non-effective structure of their production has always caused alarm and concern among specialists, especially when developing a five-year plan, a prospectus or concept. Many decisions, directives, and resolutions at different levels have already been made. Approximately once every 10 years (1964, 1974) terget resolutions were made with regard to the main types of nonmetal pipe. Thus, already in 1965 it was decided to substantially change the proportion of nonmetal pipe. Production of plastic pipe in 1970 was scheduled to be 163,500 tons, and production of pressurized pipe made from reinforced concrete was supposed to reach 1 million cubic meters.

If these schedules had been met, the pipe situation would not be so tense. Unfortunately, many of the passed decisions and scheduled plans remained unfulfilled throughout the sixties, seventies and afterwards. The scheduled level of plastic pipe production was achieved only after 15 years. As to pressurized pipe made from reinforced concrete, their scheduled production level has not been achieved as of yet. True, there are some examples of successful realization of scientific-technical progress in this area, but these examples are measured in single digits. Let us mention them anyway

With the support of the CPSU's Gorkiy obkom, a first-in-the-nation 150 km long water pipeline from Ardatov to Gorkiy, using an inner cement-sand coating, is being successfully built at the present time. Its efficiency is high: the cost of 1 m of 1,420 mm-diameter pipe is R24, operational service life is 2-2.5 times longer, and payback is 18 months. Experience of cleaning pipelines and applying protective coatings is being accumulated by the USSR Minvodkhoz [Ministry of Water Industry] and the USSR Minnefteprom [Ministry of Oil Industry]. Polymer coating technology is developed and tested at the Kazan Chemical-Technological Institute. Original equipment for applying powder polymer materials is developed at the Novosibirsk Institute of Railroad Transport Engineers.

Here, a question arises. Where are the innovations of the machine builders? What did they do to insulate the pipelines? Machine builders are silent. Little initiative is demonstrated by the enterprises themselves.

Debates Give Birth to . . . Red Tape

Today, we do not have time to get a running start. The heights must be taken right now. There is literally a "screaming" necessity for a scientifically-practical generalization of the progressive, if singular, examples and methods of pipe production and construction of reliable and long lasting pipelines built of different materials and for various purposes; there is a necessity for objective comparative technical-economical assessment and recommendations for prospective developments based on progressive norms and quotas. This part of the work is more handy for USSR Gosstroy. Gosstroy could introduce it by involving specialists in pipeline operation and engineering services of communal and industrial enterprises including power engineering capital projects and the oil and gas industry.

We shouldn't leave out the Antikor MNTK [multi-branch scientific-technical complex], the newly created Institute for Conservation of Resources (VNIIR) at USSR Gossnab and NIIPiN [Scientific Research Institute of Planning and Standards], also of USSR Gosplan. It is also reasonable to involve the All-Union Society of Inventors and Innovators in this work, who have accumulated in their files a large number of valuable and tested-in-practice technological and technical proposals directed at creating reliable protective coatings and increased quality of production, transportation, installation, and operation of pipe and pipelines.

By properly carrying out the organizational and technical aspects of this work (for example, by creating a taskforce of qualified specialists with a clearly defined purpose and tasks and having the necessary authority and rights), recommendations on the perestroyka [restructuring] of production and usage of pipe, reduction of specific metal content, increase in reliability, service life and effectiveness of pipelines, and improvements in planning and balancing the production and consumption of pipe could be developed and submitted to USSR Gosplan, USSR Gosstroy, USSR Gossnab, and USSR GKNT in just 3-4 months.

The time has come to end the debate going on for many years about who must apply the inner protective coatings to pipe: whether it be those who make them, that is, metal pipe producing plants; or those who use them, that is, construction workers. This "tug-of-war" only unjustifiably prolongs the solution of the most important problem. It has been known for a long time from world practice that coatings are applied by both pipe manufacturers and at regional construction enterprises.

We must go from words to action and create an efficient system of material incentives for all participants, namely, consumers, contractors, and pipe manufacturers, in the protection of steel pipelines against corrosion. If the overexpenditure of metal due to corrosion is paid from the government's pocket, and if a large part of pipe is imported, why couldn't it be decided that steel pipe

resources be directed first of all to those who provide pipelines with reliable anti-corrosion protection, especially when SNiP [Construction Norms and Rules] 2.04.02-84 exists, which includes a requirement for protecting the outer and inner surfaces of steel pipe against corrosion.

The practice of economic management confirms that success in realization of such large general economical problems is made more complicated because of inter-branch and inter-departmental interests. First of all, it is determined by the forming effective proportions and structures through priority allocation of respective capital investments and construction capacities, taking into account long-term requirements in products, transport connections, and international cooperation.

Of course, all this will require the development and realization of large organizational and technical measures on perestroyka of production and consumption of pipe based on a uniform balance. And what is the possible result? Calculations show that with regard to the structures discussed above, savings of more than R1 billion are acheived from reduction of specific capital investments in pipe production due to lower metal content. If one takes into consideration the increase in service life, the savings will increase by several orders of magnitude.

However, we stress that, without the scientific development of a "production—consumption" system, without the creation of a working mechanism to guarantee the realization of perestroyka, with reductions in steel pipe service life in this time of continuous growth in demand for them, the apparent shortage will become a real one. Pipe products then, instead of becoming a factor in accelerating the economy, may become a substantial obstacle for resolving the problems of fuel-power engineering, the agroindustrial and machine building complexes, and the social sphere.

Soviet, American Scientists Collaborate in Engineering Sciences

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[Article by A. P. Bessonov: "Collaboration of Soviet and American Scientists in the Engineering Sciences" (on the occasion of the signing of the Agreement on Scientific and Technical Collaboration Between the USSR Academy of Sciences and ASME]

[Text] A delegation from the American Society of Mechanical Engineers [ASME] was in the Soviet Union from 10 to 17 Nov 87. The delegation was made up of ASME president Dr R. Rosenberg, ASME first vice president Professor A. Sirig and acting ASME director, Dr D. L. Belden.

The primary purpose of the visit was to conclude negotiations and to sign the joint USSR Academy of Sciences-ASME Agreement on Scientific and Technical Collaboration. The agreement has been undergoing preliminary preparatory work for the last two years.

USSR Academy of Sciences members taking part in the talks included K. V. Orlov (Soviet delegation head), V. S. Avduyevskiy, N. G. Basov, A. Yu. Ishlinskiy, B. N. Naumov, I. F. Obraztsov, G. G. Chernyy, Dr of Technical Sciences A. K. Romanov, who is deputy chief scientific secretary of the Academy of Sciences, Dr of Technical Sciences A. P. Bessonov, and Candidate of Chemical Sciences V. A. Smirnyagin, who is chief of the USSR Academy of Sciences Foreign Relations Administration.

The talks were held in the USSR Academy of Sciences Conference Hall. In his opening address to the meeting, Academician K. V. Frolov pointed out that a great deal of work has been done over the last two years in analyzing mutual interests and possible areas of collaboration. For the most part, these have to do with the fundamental problems of scientific and technical progress, power engineering and new energy sources, problems of automating machine building, new materials and robotics, information science and mathematical modeling methods, and problems related to ecology.

"We plan to expand," said K. V. Frolov, "and strengthen our existing contacts with the US National Academy of Sciences and make further progress toward a rapprochement with the US National Academy of Engineering. We have already agreed to sign an agreement for the next three years and we will study the positive aspects of collaboration, discuss problems and come to an understanding of the problems involved and will move in the direction of expanding and improving our system of collaboration. It is noteworthy that our talks and the upcoming signing of the agreement are set for the eve of the summit meeting between CPSU Central Committee General Secretary Mikhail Gorbachev and President of the United States Ronald Reagan. And in light of this, our efforts can make a small but real contribution to the development of mutual relations between our two countries."

Academician K. V. Frolov greeted the American delegation in the name of the Presidium of the USSR Academy of Sciences and Academy of Sciences President G. I. Marchuk.

Then Dr Richard Rosenberg, president of the American Society of Mechanical Engineers, addressed the meeting, extending greetings and best wishes from all the members of the Society of Mechanical Engineers. Addressing the members of the Soviet delegation, he said, "We acknowledge and are grateful for this opportunity to become acquainted with and meet with you in person.

Like Academician Frolov, I sincerely hope that our meeting will be the first step in an extremely fruitful collaboration between our two organizations."

The president briefly familiarized those in attendance with the society's affairs, orientation and efforts. The society was organized in 1880 by a group of engineers who had joined together to solve the cardinal problem of making safer vessels, particularly boilers, and preventing them from exploding under pressure.

The society presently has a membership of 118,000 certified engineers, and is still growing. The society is well known in the USA. Its popularity stems in large part from the tremendous volume of its publishing activities which, according to the president, make it the third or fourth largest publisher in the world. Its leadership—which consists of a president, a central governing board and a board of five thematic councils lead by senior vice-presidents—works on a voluntary basis. Delegation member Professor A. Sirig is head of the Council on Machine-Building Sciences, which is one of the most active of the working councils.

The society's headquarters are in New York. Permanent staff personnel, led by Executive Director Dr D. L. Belden, handle the society's day-to-day activities. The primary activity of the permanent staff is not in New York, however, but in Washington, since it is the society's policy to make itself felt in government organizations as forcefully as possible, in order to influence society, establish contacts with governmental organizations, obtain support for its research efforts and associate with other, similar organizations also represented in Washington.

In his address, Professor A. Sirig emphasized that the USSR Academy of Sciences' research institutes and the various organizations represented within the ASME share a broad range of mutually interesting fields of knowledge. He explained that the society is made up of 35 different thematic subdivisions which encompass all engineering disciplines. Every year the society implements as many as 35 different national and international measures and publishes 15 journals or scientific papers which are widely known around the world. Professor Sirig noted that not only is the society involved in publishing new developments but also passes on new solutions and production methods, for which special journals are published, to industry. He also mentioned the fact that the society, since it is not an official government organization, will be acting in the capacity of an agency promoting or engaging in various types of exchanges of specialists, information, etc. The exchanges themselves are the prerogative of the universities and scientific centers which will be invited and received by the organizations. It can already be said confidently that many universities and research centers are enthusiastically prepared to initiate these exchanges, and need only come to an agreement on organizing them. All this needs to be incorporated into the text of the agreement. Financial questions related to the exchanges will not be included in the agreement, since they will be dealt with individually by the organizations involved in the exchanges.

Dr D. L. Belden pointed out the importance of the agreement and the willingness of the Americans to conclude it. The draft of the agreement is in full agreement with the interests of both parties and should be signed in light of the refinements expressed by the participants of the discussion. In accordance with ASME procedure the agreement, when signed, will be ratified by the society's governing board. The ASME delegation expressed the opinion that, barring obstacles, this would take place in the next 1-2 months. Academician K. V. Frolov announced that the Soviet delegation was authorized to sign the document and that no ratification was required on our part.

Academicians I. F. Obraztsov, V. S. Avduyevskiy, G. G. Chernyy, A. Yu. Ishlinskiy and N. G. Basov took part in the discussion.

The American Society of Mechanical Engineers is one of the world's largest professional societies collaborating with similar societies from major capitalist countries such as the Japanese Society of Mechanical Engineers (ISME), the German Association of Engineers (VDI) and others.

The society's charter states its goals as the exchange of information between mechanical engineers and engineers in related fields and expansion of ties and cooperation between scientists and mechanical engineering experts and scientific and technical engineering societies of various countries. The official agreement on collaboration is an effective way to accomplish this.

The signing of the Agreement on Scientific and Technical Collaboration between the USSR Academy of Sciences and the American Society of Mechanical Engineers took place on 12 Nov 87 in a solemn ceremony in the Presidium of the USSR Academy of Sciences. The agreement was signed by USSR Academy of Sciences Vice-President, Academician K. V. Frolov on the Soviet side and President of the American Society of Mechanical Engineers, Dr Richard Rosenberg, representing the Americans.

The text of the agreement states its primary goal as the establishment, expansion and intensification of scientific and technical collaboration between the above parties. This is to come about by: a) exchanging scientific and technical publications; b) setting up bilateral symposia and working groups to deal with specialized topics; c) participating in national conferences in the USSR and USA; d) establishing direct contacts between ASME and USSR Academy of Sciences departments, and e) publishing reports and books on the results of joint research.

All exchanges will be carried out on a currency-free basis. Both parties will seek additional opportunities to intensify mutual collaboration.

The agreement was signed for a term of three years and will be extended for the following three years if neither party wishes to suspend it or to insert changes or addenda. The agreement is considered to be a first important step in cooperation, but it is not enough to qualify as full-scale collaboration. Over the long term, we can also anticipate that joint collectives will be set up to solve major scientific and technical problems. Such collectives will not only be of mutual scientific and technical interest for our countries, but will be globally significant as well. The problems they will deal with include those related to power production, the use of new sources of atomic and nuclear energy, solar and wind power, ecological problems which include nature conservation and noise pollution, and new types of urban and long-distance transport. The development and utilization of progressive production methods and automation, including the use of industrial robots, the development of new materials with advanced western properties and characteristics, and the ensuring of safety in the frictioning [friktsionirovaniye] of atomic power plants and stations, and all these questions must be closely geared to the economy.

In the long run, if the joint efforts of the scientific collectives turn out to be effective, questions of setting up joint collectives with the United States may be raised, as well as the possibility of multilateral enterprises and firms using advanced science and production methods, and operating to the economic advantage of both sides.

The American delegation was received by the CPSU Central Committee and also spoke with Chairman of the USSR State Committee on Science and Technology B. L. Tolstoy and I. S. Silayev, chairman of the Machine-Building Bureau of the USSR Council of Ministers.

Then the delegation of American scientists left for Leningrad, where they visited the Science Center of the USSR Academy of Sciences and the All-Union Scientific Research Institute of the Electric Machine-Building Industry.

First ASME Vice-President, Professor A. Sirig returned to Moscow and was received by Academician G. I. Marchuk, who is president of the USSR Academy of Sciences. Academician K. V. Frolov and Professor A. Sirig discussed the progress of the talks and the spirit of collaboration with the academy president and they exchanged views on the prospects of developing mutually advantageous contacts.

For purposes of familiarization, the American scientists visited the USSR Academy of Sciences Institute of Mechanical Engineering, the USSR Academy of Sciences Physics Institute and the USSR Ministry of Health's All-Union Hyperbaric Oxygenation Center.

UDC 531.383

Gyrocompassing of Biaxial Gyrostabilizer With Nonvertical Stabilization Axis

18610226 Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 31 No 1, Jan 88 (manuscript received 24 Mar 87) pp 38-42

[Article by V. V. Meleshko, Kiev Polytechnic Institute]

[Abstract] The problem of gyrocompassing a biaxial gyrostabilizer with a nonvertical stabilization axis is analyzed, feasibility of gyrocompassing a triaxial one having already been established. An inertial platform is considered in an outer gimbal with a slightly nonvertical axis on a stationary base, a pair of two-frame gyroscopes serving as platform position sensors. An accelerometer generates a roll signal when the platform tilts from horizontal position, the platform position being controlled through two torque transducers. The motion of the platform is analyzed on the basis of the corresponding equations of precession, assuming that the two gyroscopes have equal angular momentums, for calculation of the control torques necessary for gyrocompassing such a gyrostabilizer in a meridional plane and eliminating the kinematic drift of its platform due to rotation of the Earth. The analytical solution is checked for accuracy, after simplifying assumptions, and for length of the gyrocompassing time. The results have been verified by numerical simulation on a digital computer. Figures 3; references 4: 2 Russian, 2 Western.

UDC 531.383

Determination of Platform Drifts in Triaxial Gyro Stabilizer

18610214b Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30 No 12, Dec 87 (manuscript received 31 Jul 86) pp 46-52

[Article by O. B. Sinkovskiy and S. V. Sokolov, Rostov-na-Donu]

[Abstract] Instantaneous drift of the platform in a triaxial gyro stabilizer is calculated, assuming force stabilization within the terrestial sphere and a polynomial dependence of the drift rate on the acceleration or, more precisely, on its projections. The problem is analyzed in four right-hand coordinate systems: stationary inertial, astronomical, $Ox_iy_iz_i$ ($i = 1,2,3$) on the i-th gyro module, and OXYZ on the platform. A model of platform motion is constructed with the aid of a finite-rotation matrix. Instantaneous projections of the acceleration are calculated by the method of successive approximations. Numerical solution of the problem has been programmed on a YeS-1035 computer, the three drift components at discrete instants of time over a period of 10,000 s having been calculated for a typical stabilizer platform. Figures 3; tables 1; references: 4 Russian.

UDC 531.383

Two-Gimbal Suspension of Dynamically Tuned Gyroscope
18610214a Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 30 No 12, Dec 87 (manuscript received 10 Mar 87) pp 42-45

[Article by Yu. I. Kuznetsov, Perm Polytechnic Institute]

[Abstract] A two-gimbal suspension of a dynamically tuned gyroscope is considered, the second gimbal ensuring that the elastic moments are balanced by the inertia forces at every instant of time rather than on the average-per-revolution basis and thus eliminating vibrations at the double-speed frequency while at the same time being a source of additional drift. For design and performance analysis, the elastic elements in such a suspension are replaced with rotational kinematic pairs intersecting at one point so as to preclude translatory motion. Five such pairs reduce the degrees of freedom from 12 to 10, the wheel now having only two and not three it has in a one-gimbal suspension. The static torque necessary to apply for maintaining the wheel at equilibrium in a new position is calculated by the method of virtual displacements. From the balance of moments is then determined the drift rate. A typical numerical example is included. Article was presented by Department of Aviation Instruments. Figures 2; references 2: Russian.

UDC 531.8

Wall Climbing by Walking Robot
18610231 Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA in Russian No 1, Jan 88 (manuscript received 18 Jun 85) pp 40-43

[Article by Yu. F. Golubev and D. V. Solntsev]

[Abstract] Wall climbing by a walking robot is analyzed on the basis of the fundamental equation of vertical motion (where the robot maximally utilizes frictional forces from the wall's reaction), and the equation which describes the horizontal recoil motion of the robot. Solution of this system of two differential equations yields the optimum recoil mode which will ensure the maximum height reachable, and also that maximum height. Quantitative values of kinematic parameters thus obtained are shown in tabular form. It is shown that for friction constant near unity and initial horizontal velocities of 8.3 to 11.1 m/s, barriers on the order of 2-3m can be surmounted with relatively short legs (1-2m).

UDC 666.942.693.54

Gypsumless Portland Cement With Potash Added for Winterization of Concrete
18610153 Moscow BETON I ZHELEZOBETON in Russian No 3, Mar 88 pp 21-23

[Article by L. G. Shpynova, doctor of technical sciences, professor, M. A. Sanitskiy, candidate of technical sciences, and O. Ya. Shiyko, engineer, Lvov Polytechnic Institute; O. S. Ivanova, candidate of technical sciences, All-Union Scientific Research Institute of Reinforced Concrete]

[Abstract] Addition of potash to Portland cement is used for concrete construction work in the subarctic permafrost regions of the USSR, when the wet cement freezes at -36.5°C and does not corrode the steel reinforcement. However, potash thickens quickly, so that addition of retarders for regulation of the setting time lose their effect with 12-15 mass percent potash in the cement and, moreover, one quarter to one third of this potash reacts with the gypsum forming two non-frost-resistant compounds: calcite and arcanite. In a cement mass with less than 4 percent potash the latter reacts with gypsum forming syngenite, so that thickening is further accelerated and another retarder must be added to replace the depleted gypsum. It is therefore proposed to remove the gypsum from Portland cement, adding instead LST retarder, which has been found to be an excellent replacement for setting time regulation. An experimental comparative study of concrete with plain or gypsumless Portland cement and 2.5-10 percent potash plus 0.5-1.0 percent LST at -15°C and -25°C has established the optimum range of mix compositions for maximum strength of concrete after 28 days of curing. The results indicate that the absence of gypsum and the proper dosage of LST allow appreciable savings of costly potash. Samples from four cement mmanufacturing plants (Ivano-Frankovo, Zhigulevsk, Novo-Ulyanovsk, Achinsk) were tested. Figures 2; tables 3; references: 4 Russian.

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